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SEWAGE UTILIZATION NEAR PARIS.

The sewage of Paris, which formerly wasted directly into the Seine, now flows into a subterranean canal which conducts it to Asnières, about four miles from the city, and there delivers it into the river. The consequence is that, while the water of the latter is little contaminated as it flows through Paris, that which passes the villages below Asnières is black and polluted, and wholly unfit for either domestic or industrial uses. Not merely are the waters rendered impure, but they are heavily charged with solid matter which fills up the channel at the rate, it is estimated, of nearly ten million cubic feet per year, thus obstructing navigation and furnishing a dangerous source of infection during low water. The population along the stream have long protested against this practical confiscation of the river by the capital.

In order to remedy this condition of affairs, two systems have been suggested. One involves the direct utilization of the sewage for agricultural purposes, as it is a valuable fertilizer, and the other its complete disinfection and clarification before diverting it into the Seine. The municipal government, desiring to test both systems, charged two engineers, MM. Mille and Durand Claye, with that duty; and experiments were begun on a small scale in a meadow at Clichy. Trials have subsequently been continued on the plain of Gennevilliers, near the river. The engravings given herewith represent the experimenting field, Fig. 1, and the basins in which the chemical processes of purification are carried on, Fig. 2. From the orifice of the subterranean canal leading to Asnières, the sewage is forced by steam pumps into conduits which cross the Seine under the sidewalk of the Clichy bridge; and thence it flows from this receptacle into a reservoir. The sewage travels in a canal to the experimenting field. The main canal is a little above the general level, so that the material easily flows into the smaller canals, which may be compared to the arteries of the system, and thence to smaller conducts or feeders, analogous to the veins. These feeders mark the boundaries of the various parts where marsh cultivation is carried on. The sewage being thus brought within reach of the gardener, its expenditure is regulated by the latter, simple means being provided whereby the supply may be diminished or shut off from any portion of the area under cultivation, or whereby the entire surface may be flooded.

The surplus water runs into three huge masonry basins, in which sufficient sulphate of aluminum is placed at a time to purify a month's inflow of sewage. The water, thus rendered pure and colorless, is led into the Seine. Every month the basins are strained, the deposit collected, dried, and sold as manure.

Recently attempts have been made to utilize all the sewage of Paris for fertilizing purposes, without diverting any of it into the Seine; and to this end arrangements have been made to distribute the sewage over an immense tract of land near Gennevilliers. This plan, however, so far from benefiting the farmers, has only served to arouse their strong opposition. The enormous mass of water absorbed by the soil of the experimenting fields has corrupted the underground springs which supplied the wells, caused inundations in cellars, and resulted in the production of infectious and malarial disease. At the same time, it is stated, while the vegetables grown on this sewage-soaked ground are larger and finer in appearance than is usually the case, they are watery, poor-tasting, not nutritious, and do not keep well. As matters now stand, the problem is an open one. Paris cannot continue to pour her sewage into the Seine at Asnières for the reasons already stated; nor can the distribution of the sewage over the adjacent country be carried on without the bad results noted. The consequence is that some plan, which will admit of the utilization of this valuable material without prejudicing any one's interest, is just at present very much desired. The sewage question is an open one the world over; and as it has vexed the brains of engineers for many years, we need scarcely hope for any speedy solution of it. Still, in the case of Paris, there is every opportunity of experiment, and an exceptionally urgent need, and therefore the requirements of the French capital may well prove the subject of extended investigation by our American sanitary engineers. There certainly is an excellent opportunity for some one to solve the problem and earn both fame and great reward.

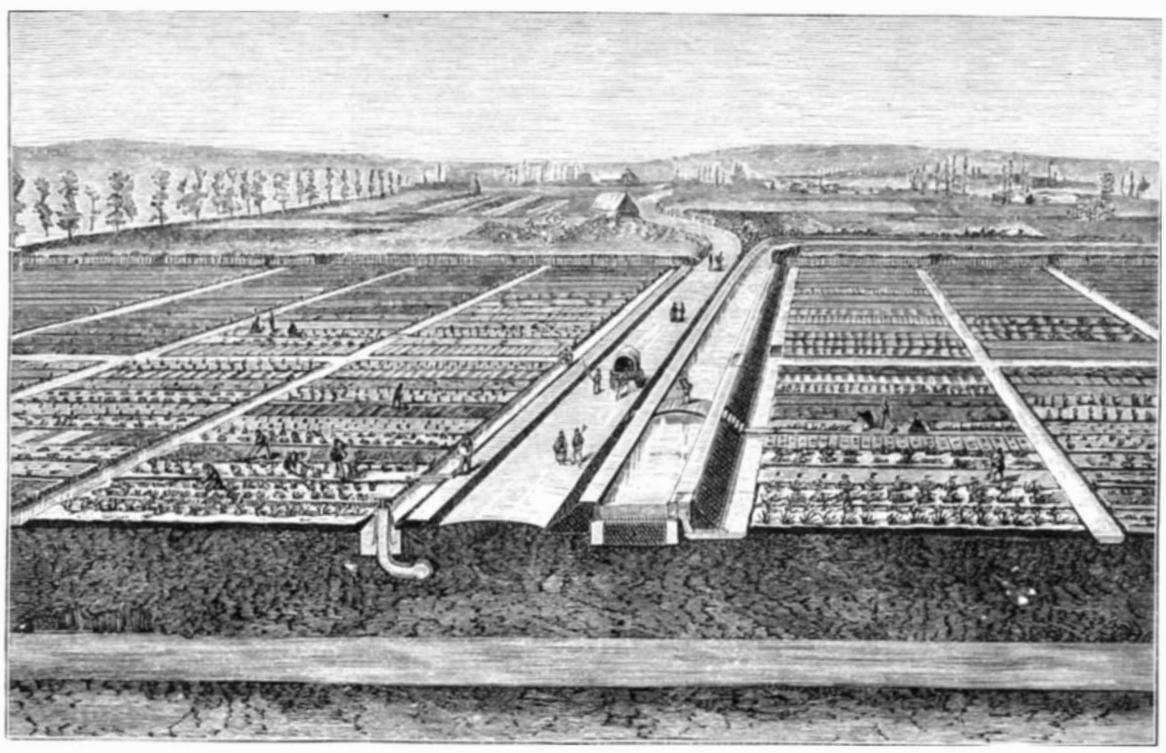

Fig. 1.—SEWAGE-IRRIGATED FARM, GENNEVILLIERS, NEAR PARIS.

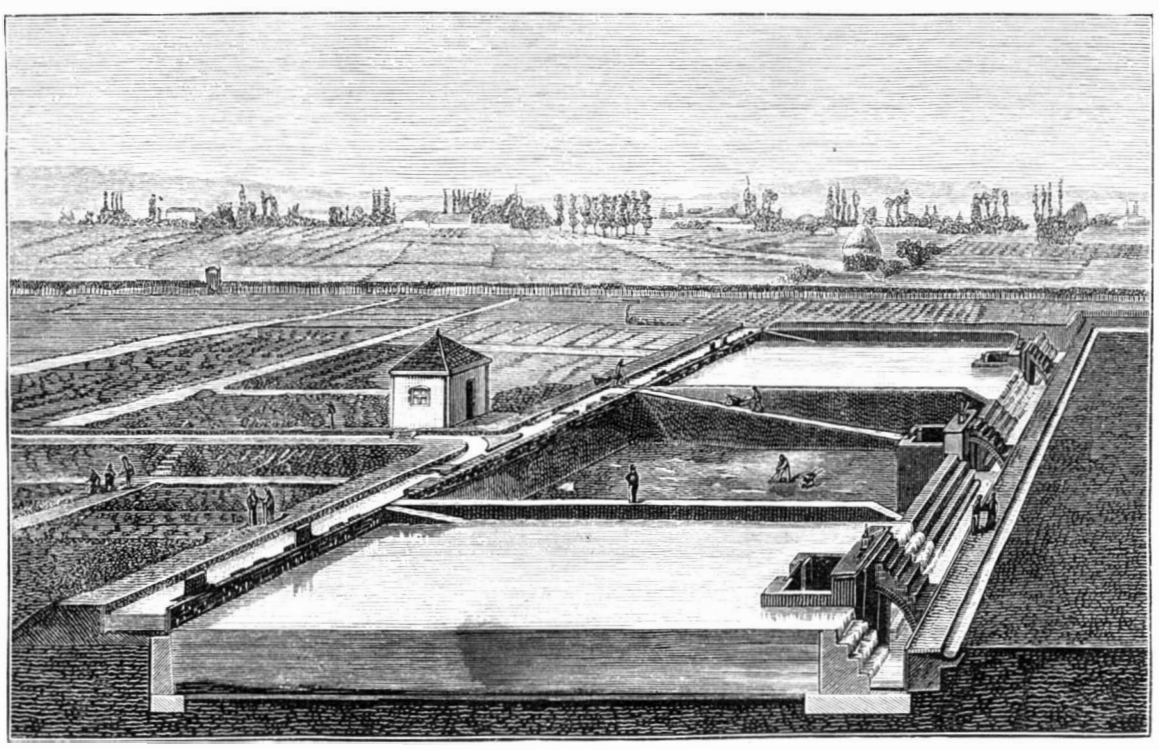

Fig. 2.—SEWAGE-PURIFYING BASINS, GENNEVILLIERS, NEAR PARIS.

Heat.

Recently, in resuming his lectures at the Royal Institution, Professor Tyndall, having caused a ball of lead to fall from the roof of the theater on to a stone, he drew the ball up again and let it down gently with a string and pulley. The heat generated by the collision in the first instance was the exact equivalent of the heat produced in his finger and thumb and in the string in the second instance. The outlay of muscular force expended in drawing up the ball was made obvious by causing the ball to be drawn up again by a small engine worked by compressed air. The exact equivalent of the heat evolved by a quantity of coal, completely consumed by consumption with oxygen, sufficient to lift a weight of 50 tons to a height of 100 feet above the earth, would be produced by the collision of that mass with the earth when allowed to fall. Given the velocity of a body, the heat generated by the destruction of that velocity could be easily calculated, and some time ago he was led to the conclusion that the stoppage of a rifle bullet would produce sufficient heat to fuse the metal. This conclusion was proved in the Franco-German war, when bullets which had been stopped by contact with a bone showed on being extracted undoubted marks, in many cases, of fusion. The same thing had also been illustrated incidentally in the experiments with gun cotton at Stowmarket. The old notion of heat was that it was a substance which could be squeezed out of matter as water was squeezed out of a sponge. A bullet squeezed in a hydraulic press acquired heat, rendered obvious in the galvanometer by the thermo-electric pile. Even as late as the time of Faraday it was conceived that heat was something for which some bodies had a greater capacity than others. If compressed air from one vessel were allowed to pass into a vessel in which the pressure was much less, it would then have been said that the motion of the air gave to the comparatively empty vessel a greater capacity for heat. The heat thus produced was shown by means of the galvanometer and the thermo-electric pile; the reason for that heat was differently understood now. The co-efficient of expansion of gases was next described; and the explanation of different metals, when subjected to the same degree of heat, not possessing in themselves the same amount of heat, was that heat had two operations, one the production of tremors (which were heat), the other the weakening of molecular attraction. Thus, if lead and iron were exposed to the same high temperature, the lead would be much hotter than the iron, because in the former case less internal molecular work was performed, and more heat was expended in the production of tremors; while in the latter case more heat was used up in internal work, and less in the production of tremors. The same degree of heat was in operation, but the apparent results were different.

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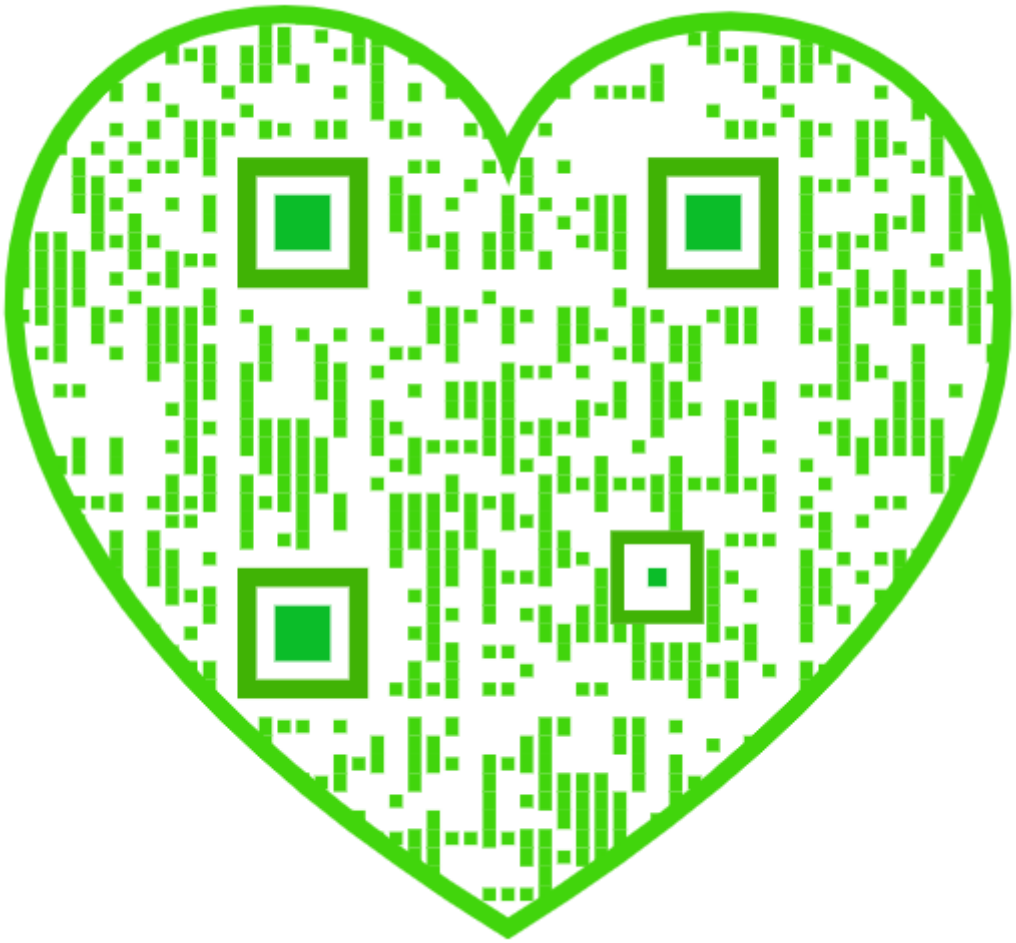

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NEW YORK, SATURDAY, JUNE 16, 1877.

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PROGRESS OF ELECTRIC ILLUMINATION.

In describing the Jablochkoff electric candle, recently, we noted the fact that the inventor was engaged on further experiments, and that new discoveries would doubtless soon be forthcoming. M. Jablochkoff now announces that he has succeeded in dispensing with the carbons of his candle altogether, and derives the light from the insulating material alone—a proceeding somewhat analogous to throwing aside the candle and igniting the candlestick. In fact, we cannot see that the inventor has left anything of the original electric lamp at all. He began, a few months ago, by abolishing all the elaborate regulating mechanism, and produced simply a pair of carbon rods, placed parallel, separated by an insulating partition of clay and held in a metal casing. This was made the subject of experiments by a War Office Committee of Royal Engineers, at Chatham, England, where the apparatus was demonstrated to give 50 per cent greater power of light than had ever before been obtained from any electric light.

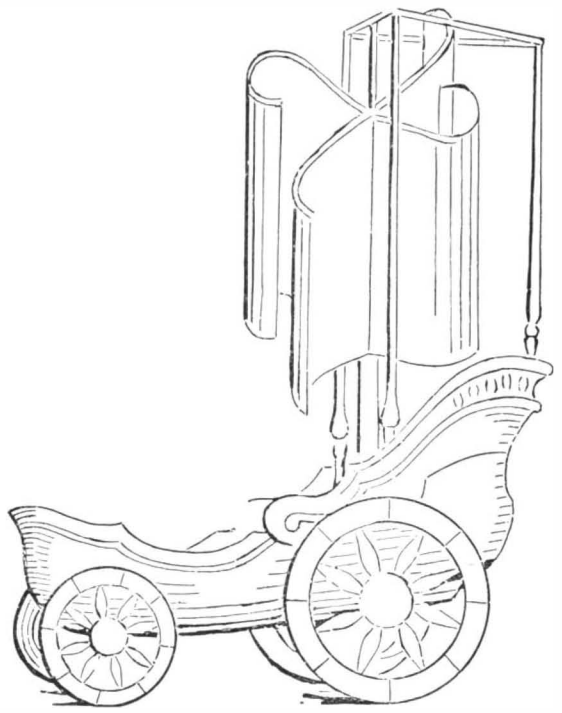
Not contented, however, with this showing, M. Jablochkoff proceeded to denude his candle of its outer casing, leaving merely a double carbon wick with a strip of the insulating compound between the carbon points, which terminated at the bottom in metallic tubes as before. It was this form which we recently illustrated; and with this, M. Jablochkoff succeeded in arranging means for dividing the current, so that, instead of one very powerful light, he had eight from one and the same circuit. Six of these lights illuminated Marengo Hall in the Louvre, Paris, with a brilliancy equal to that of 100 argand gas burners of the largest size. The East and West India Dock Company, of London, recognizing the value of the invention, began at once to make arrangements to use it for illuminating one of their docks; and hardly have these arrangements been completed, when M. Jablochkoff now discovers that he can dispense with the carbon points altogether, and obtain the required light by passing the electric current through the insulating material itself, which is simply kaolin clay. It seems that, while experimenting with sparks from a current of great tension, the inventor passed them through a plate of kaolin, placed between the two ends of the wires from a couple of coils in which the current was induced by a magneto-electric machine. He then found that, although the current was unable to fuse the kaolin, it did heat it to incandescence. By priming the kaolin plate with a better conductor, he then succeeded in obtaining a very brilliant light with a very small consumption of kaolin, so small, indeed, that a kaolin plate barely half an inch in length is sufficient for a small light burning ten hours. A band of kaolin may be made to give a magnificent light; and as, practically, any desired number of coils can be placed on the circuit of the magneto-electric machine, and each coil can be made to produce an electric light, the divisibility of the light appears to be all that can be desired. In fact, the inventors—for M. Denayrouze is associated with M. Jablochkoff—have produced a series of electric lights of intensities varying from the equivalent of two gas jets to as many as fifteen. What is more, any one of these lights may be turned out, or the whole illuminating power of the current diverted into one burner.

The inventors state that they have used bands of kaolin longer than the induction spark which the coil is capable of making, and that the intensity of the light, which is soft and uniform, depends on the number of spirals and diameter of the wires used in the coil. By using fifty coils, M. Jablochkoff says, it is easy to obtain as many lights of variable intensity. He has arranged coils so as to give a series of gradually increasing lights, ranging, as before noted, from two to fifteen gas burners in power. By using alternating currents the interrupter and condenser of the induction coils are dispensed with. The total system of distribution of currents is then reduced to a central artery represented by the series of interior wires of the coil, branching from which are as many distinct conductors as coils are placed in the circuit. It is proposed to employ the carbons arranged as previously described where an intense light is desired, and to adapt the kaolin light to the ordinary illumination of streets and buildings.

This is electric illumination *minus* voltaic arc, regulators and carbons, in fact, *minus* everything except the electrical generator, wires, and kaolin. M. Jablochkoff is still at work, and promises even further improvements.

SAILING AGAINST THE WIND.

Wendell Phillips, in his famous lecture on the "Lost Arts," used to delight in trying to convince his hearers that the ancients were more ingenious than the inventors of the present day; and it is well known that rude copies of some of our most noted devices have been discovered among the relics of past ages. Hence, without denying the possibility of there being anything new under the sun, we may naturally hesitate to believe that every so-called new invention had no counterpart in former times. An instance of a singular coincidence in the views of two inventors, at an interval of nearly two centuries, may be of interest. John Wilkins, Lord Bishop of Chester, and Member of the Royal Society, was equally celebrated as a philosopher and as a divine; and his writings on scientific subjects contain much interesting and valuable information. His treatise on "Mathematical Magick," first published in 1648, has a chapter entitled: "*Of a Sailing Chariot, that may without Horses be driven on the Land by the Wind, as ships are on the Sea.*" In this, the writer speaks of the sailing chariots which were used by the ancients, and after describing their construction, goes on to say: "I have often thought that it would be worth the experiment to enquire whether or no such a Sailing Chariot might not be more conveniently framed with movable Sails, whose Force may be imprest from their Motion, equivalent to those in a Wind-mill. Their foremost Wheels (as in other Chariots) for the greater Facility, being somewhat lower than the other, answerable to this Figure, in which the Sails are so Contrived, that the



Wind from any Coast will have a Force upon them to turn them about; and the Motion of these Sails must needs turn the Wheels, and consequently carry on the Chariot itself to any Place (though fully against the Wind) whither it shall be directed. The chief doubt will be, whether in such a Contrivance, every little Ruggedness or Unevenness of the Ground, will not cause such a jolting of the Chariot, as to hinder the Motion of its Sails. But this perhaps (if it should prove so) is capable of several Remedies. I have often wondered, why none of our Gentry who live near great Plains, and smooth Champions, have attempted anything to this Purpose. The Experiments of this kind being very pleasant, and not costly: What could be more delightful, or better Husbandry, than to make use of the Wind (which costs nothing, and eats nothing,) instead of Horses? This being very easie to be effected by those, the Convenience of whose Habitations doth accommodate them for such Experiments."

Now comes the proprietor of the "Universal Wind Power," with a patent granted last year, for a carriage propelled by a windmill, which, he says, "runs readily against the wind as well as in any other direction." He has gone further than Bishop Wilkins, for he has built a machine which has satisfactorily demonstrated its ability to do what is claimed for it; and now the inventor offers it for use in localities where there is plenty of surplus wind. On prairies and the sea coast, it is not improbable that this machine would prove very useful. Doubtless the proprietor of the "Universal Wind Power" believes that he is the original inventor of the device; but it may well be doubted whether he can hold the patent right to the use of the invention as a whole—that is, to the application of a windmill to a vehicle.

PASSAGE OF THE NEW GERMAN PATENT LAW.

We announce with much pleasure the promulgation of the new patent law for the German Empire, to take effect on and after July 1 next. This new law, although it is not quite up to the progressive ideas of our countrymen, is nevertheless a great improvement on the previous system, and opens to American inventors an additional market, of large extent, for their new ideas.

Heretofore it has been necessary in order to patent an invention in Germany to take separate patents in each separate State, of which there are twenty-one. Thus twenty-one sets of drawings and specifications were necessary, for each of which an agent must be employed and special fees paid. The total expense was so great that few patents were ever taken; the applications being confined to the larger States, foremost among which was Prussia. But here, unfortunately, was in vogue a stringent and narrow-minded system of official preliminary examination, resembling that which prevailed in this country twenty or thirty years ago. Under this Prussian system, patents for the most valuable improvements were rejected. Thus a patent for the Howe sewing machine could not be allowed in Prussia because it was not considered by the Prussian patent office examiners to be an original invention, but merely an improvement on some former attempt to sew by mechanism. A patent for the celebrated American invention of Broadwell, for gas-check rings for breechloading cannons, was refused in Prussia on similar grounds; but the Prussian Government copied Broadwell's plan and introduced the invention into its army and naval service, without allowing him any compensation. The celebrated German guns of Krupp are provided with Broadwell's invention, without payment to the inventor; although, with-

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out the invention, Krupp's guns could not be successfully used. All of these objections are removed by the new law, which permits the patenting of improvements of all kinds except medicines and foods, as articles; but the processes of producing such articles can be patented.

The duration of the new patent is 15 years. It extends over the entire German Empire, comprising twenty-one States, and embracing an aggregate population of about fifty millions. more or less.

Every patent is to be granted subject to the payment of an annual tax: subject also to a commencement of the working of the invention within the limits of the empire, within three years from the date of the patent.

These are some of the principal provisions of the new German patent law, concerning which we shall from time to time give our readers additional information.

In the meantime we would give notice to the many patrons of the Scientific American Patent Agency that Messrs. Munn & Co. have already completed their arrangements for taking patents in the German Empire under the new law, and are now ready to receive and give prompt attention to all applications. The proceedings are simple, and the costs light; the expenses, including the first year's taxes, amount only to one hundred dollars. Circulars of information, with particulars about the new German law and the patent laws of other foreign countries, England, France, Belgium Austria, Italy, Spain, Russia, etc., may be had gratis at this office.

TAXING POWER OF THE LEGISLATURE.

In our issue of July 18, 1874 (page 32, volume XXXI), an article appeared quoting a portion of a then recent opinion of the court of last resort of the State of New Jersey, at the suit of "The Mayor, etc., of Newark *vs.* Agens *et al.*," which held in substance that the power of the legislature to tax or assess property, along the line of and for local street improvements, was limited to the special benefit which the property derived from such improvements. This position was contrasted with the nearly opposite view of the Court of Appeals of the State of New York, whose decisions have gone further perhaps than those of any other State in the Union, in holding that the power of the legislature was supreme in all matters of taxation, or, in other words, that "man was made for the State and not the State for man." The practical operation of this rule has been that, in many of our large cities, streets and boulevards have been built through pastures and swamps, under these legislative acts, without the wish or consent of a majority of owners; and the vast cost, with high prices and great frauds added thereto, has in many cases confiscated the property and ruined the owners; and the latter, under the decisions of our courts, have been without remedy.

That such a state of affairs should exist under a government *not omnipotent*, but where the people are supposed to rule, has led to much serious thought and discussion. It seems to have been considered by our courts quite fully, in the suit of Weismer *vs.* Village of Douglas—just reported in 64 N. Y. Reports, page 91—opinion by Judge Folger.

While this case turns upon the question of the constitutionality of the legislative act which authorized the village to issue bonds, to raise money, to pay for stock subscribed for, and collect by taxation to pay the bonds, yet the court, in its able opinion, holding the act unconstitutional, lays down a broad doctrine of equity, which, if applied, will relieve the people from many wrongs and much legalized robbery, even if it does not check reckless legislation. Honest taxpayers have long suffered from oppressive legislative acts; and whatever the future may disclose, they have seemed in the past to have no proper remedy in the courts.

ZINC-LINED WATER COOLERS.

Several correspondents have lately written to us concerning zinc-lined water coolers, complaining of the disagreeable flavor which the zinc imparts to water from melted ice. Several weeks ago, we had occasion to note the deleterious effects of water that had passed through zinc-coated or galvanized iron pipes. It is obvious that what was there said equally applies to zinc or galvanized iron-lined water reservoirs of any kind, although we admit that the corrosive action of any fluid is greatly diminished by a reduction in temperature. We think there can be no manner of doubt that the use of zinc or galvanized iron for such purposes is highly objectionable. The general action of zinc salts on the animal system is to cause persistent diarrhœa; and in conjunction with the enervating effects of hot weather and other causes tending in the same direction, this may result in very serious consequences—more especially with young children and persons suffering under the infirmities of age. During the next few months, these ice water fountains will receive marked attention, so also will cholera mixtures. If our readers would avoid headache and nausea, let them banish these "crystallized" coolers. The best lining for such vessels is, perhaps, porcelain enameled iron; but. unfortunately, there is always a doubt as to the amount of soluble lead the enamel may contain. We have seen some of these enamel-lined coolers in the market; but as they cost nearly twice as much as an ordinary cooler, their sale is very limited, while the handsome galvanized iron ones are found nearly everywhere. Tinned plate has been found unsuitable as a lining material, as the tin soon wears off and exposes the iron. Iron discolors and imparts a disagreeable styptic taste to the water. Glass, porcelain in general, and stoneware or pottery, if free from lead glazes, may be used. Sawdust is often used in lining the walls of water coolers; but charcoal, in moderately fine powder, is much superior. Care should be taken, in filling the vessels with water, not to wet the lining, as when wet it becomes almost useless. Ice water—that is, water from melted ice—is not conducive to health; but it becomes more pernicious when its reservoir has been a zinc-lined vessel.

QUADRUPLEX TELEGRAPHY.

"We are not aware," says the editor of the London *Telegraphic Journal*, "that a quadruplex circuit exists in England at present, although we are assured that since 1874 quadruplex telegraphy has been an established fact in America, and that its employment there has been eminently successful. Statistics are nevertheless wanting to establish its practical value."

* * "We seem to be still as much in the dark as ever to the real advantages of quadruplex telegraphy. Without entering at all minutely into the system, it is sufficient to state that the difficulties inherent to the adoption of quadruplex telegraphy are greater than at first sight would be imagined."

* * "Working a quadruplex system—that is, four circuits upon one wire—to meet the requirements of busy centers of commerce, looks very much like intrusting too many of the eggs to one basket, and in the event of interruptions could not fail to be attended with the most serious inconvenience."

For the information of our valued British cotemporary, we would state, by way of statistics, that the Western Union Telegraph Company is now regularly operating, daily, by the quadruplex system, about twenty thousand miles of its wires. The lines between New York and all the large cities, as Boston, Philadelphia, Pittsburgh, Chicago, St. Louis, Washington, New Orleans, are worked by the quadruplex plan.

For the illumination of our cotemporary, we would state that the real advantage of quadruplex telegraphy is that it permits the sending of four messages over one wire during the time heretofore required for sending one message by the old method. In other words, as much business may be done over one wire, by the quadruplex, as can be done over four wires by the common plan.

There are no inherent difficulties about the adoption of the new system in England. All that is needed is to send over to New York a postal money order and pay for as many instruments as are wanted, and then set them to work. They will work just as well in London as here.

To stand in the gallery of the great operating room of the Western Union Company, in this city, and gaze upon the multitude of operators there daily at work with the quadruplex instruments, does indeed seem like looking upon a good many eggs in one basket; but we hear of no inconvenience or interruptions therefrom resulting. On the contrary, so great is the regularity and necessity for the new system that the business of the Western Union could not now be transacted except for the quadruplex, the use of which is being rapidly extended. Finally, we suggest to our cotemporary that he make a summer excursion over here and learn something about modern telegraphy. The absence of the quadruplex in England shows conclusively that his countrymen are several telegraphic generations behind the age.

LOCUST PROSPECTS.

BY PROFESSOR C. V. RILEY.

Before spring opened, the most gloomy forebodings prevailed throughout the so-called Western States as to the prospective injury from the Rocky Mountain locust. Nor were those forebodings without foundation. Eggs were laid last fall over an immense stretch of country, from the 94th to the 98th meridian, and in some cases reaching into the mountains, and from near the British American line to the Gulf of Mexico. They remained for the most part sound throughout the winter; and notwithstanding that those which prematurely hatched, or were destroyed by the many different animals that feed upon them, more than sufficient remained as the ground thawed out to give birth to locusts enough to ruin most crops. The young insects began to hatch whenever the weather was favorable, often in such quantities as to daunt the most hopeful: they were graphically described as "boiling out of the ground," and they began to mow down the more succulent plants and to do great injury to young wheat. In some sections, the farmer was prepared and determined to make a fight; and wherever the war was waged with spirit, brains, and concerted action, the foe was vanquished. Yet in many, if not most, instances, he would have given up in despair, had not Dame Nature come to his aid with various most efficient allies. The insects soon began to disappear and to lose their voracious appetites, and at the present time there is, in most of the threatened country, no longer serious alarm, but, on the contrary, every prospect for more than average crops.

Having recently returned from an extended tour of investigation in Texas and Kansas, I take the liberty of quoting from a letter written on the 10th of May and addressed by me to the Governor of the latter State, that portion which bears more particularly on the disappearance of the young locusts:

"In every part of the State I have visited, and where I have examined carefully the condition of things, the young locusts have very largely—in some instances totally—disappeared; and I now have no doubt whatever that the reports of such disappearance that are so general throughout the entire portion of the State that was threatened have their foundation in fact. This disappearance is generally attributed to death and dissolution from the cold and wet weather that followed the principal hatching. That this weather has been largely instrumental in causing death among the hopping pests I have no doubt, because there are always a certain portion just hatched or just molting, which are particularly tender and susceptible to the injurious effects of cold, drenching rains. But they have been yingd and are now dying fast during the present warm and sunny weather, and these dead insects are not parasited, but simply diseased—sick. In my last (9th) report made to the State of Missouri, in stating the causes that might diminish the prospective injury, I wrote:

'We may therefore expect that, as compared with 1875, a larger proportion of the young that will hatch in 1877 will be weakly and will soon perish.* * * * There is a bare possibility that, after the bulk of the young have hatched, and before they have commenced to do serious harm, we may have such unseasonably cold and wet weather as to kill them by myriads, and effectually weaken their power for injury.'

Both possibilities have become actualities.

It is a singular fact, however, that, notwithstanding the large numbers which hatched, no one has been able to discover the dead carcasses of these disappearing locusts in anything like the numbers necessary to account for the disappearance; and in most instances where dead insects have been reported to me, an examination at once showed that the parties had mistaken therefor the exuviæ or empty skins of those which had molted; which skins are always abundant under straw or weeds, or at the base of a wheat stool, where the young insects congregate when undergoing their molts.

The young locusts possess remarkable tenacity of life; and the fact that the bulk of those remaining are in the third stage (that is, have molted twice) and must have hatched before the unfavorable weather set in, is in itself enough to show that other factors than those meteorological have entered largely into the problem of disappearance. The principal of these I will briefly enumerate, because, unlike meteorological or climatic influences, they may, most of them, be relied upon in future, are largely within man's control, and may even be rendered still more effective. They are, in short, elements of certainty in the problems of locust destruction:

First—The natural enemies of the locust. These consist in the present instance (the parasites not affecting it till it gets older) of the vertebrate animals which are known to feed upon it, such as snakes, gophers, field mice, etc., and birds. These last have been more efficient than most of us imagine, and I never saw blackbirds, plover, the Lapland longspur, etc., so numerous. The dung often whitens the fields where the locusts were once thick, and they have been the principal cause of the latter's disappearance. The prolonged cold and wet retarded the development of the insects, benefited the wheat, and gave our feathered friends an excellent opportunity to check them. We should employ all means to encourage the multiplication of the birds.

Second—The farmers. In most parts of the State I have traversed, the farmers had determined from the beginning to make war, and they did make war, and so successfully that the insects were pretty effectually destroyed before the cold and wet occurred. The means employed were mostly kerosene pans and burning—over 700 kerosene pans having been made at Salina alone.

Third—The weather. The continued cold, after the principal hatching, had the effect, as already stated, to kill many that were just hatching or molting. The heavy rains also washed many away into the streams; and in some instances, on soils which contain sand and lime, and which are liable to crack when dry, the rains doubtless covered up and killed such as were sheltering in such fissures.

Fourth—Climate. The fact that the insects, especially after the second and third moltings, are dying, is simply confirmatory of the views I have always held and advanced, that the species is out of its natural habitat, and can never permanently thrive here. These views I need not repeat at length here. While the number that have become sickly and died have not so far begun to compare with those which have perished in the other three ways mentioned, it will doubtless continue to increase as the insects get larger, for already they show a tendency to unnaturally group together during the heat of the day, and feed much less ravenously than when in perfect health."

It affords me pleasure to be able to state that the favorable condition of things reported in the above-quoted passage is not confined to Kansas, but is general. In parts of Minnesota, where the eggs were so thick that to dig the ground when at all moist was to make a paste, the little red mite (*trombidium sericeum*) has swarmed and destroyed them. In other places birds have pecked the ground full of holes in their search for eggs; and from Iowa, Nebraska, and Colorado, the reports are almost unanimous that the young insects that continue to hatch also continue to perish.

A survey of the field at this writing gives every assurance of good harvests throughout the threatened country. They are needed! With ruined crops this year, following so closely the injury of the past few years, many a farmer would have been bankrupt, and the whole country would have seriously suffered. The sickliness of the locusts as compared with those of 1875 is a most encouraging sign. Comparatively few will live to get wings. Those that became fledged in Texas are passing northwest in scattering and insignificant flights. The Saskatchawan plains and the northwestern hatching grounds were pretty well depleted last year; and there is every reason to hope for freedom from any general and disastrous invasion for some years to come.

St. Louis, Mo.

Sideraphthite.

Sideraphthite is the name given to a new alloy composed of 66 parts of iron, 23 of nickel, 4 of tungsten, 5 of aluminium, and 5 of copper. It is said to resist sulphuretted hydrogen and the vegetable acids, and to be but slightly attacked by mineral acids. It is really more useful than silver, and can be prepared at less cost than German silver.

In our notice of Mr. D. L. Holden's patent for an ice machine, published on page 330 of our issue dated May 26, we gave his address as "Carrington, Ky." It should be "Covington, Ky."

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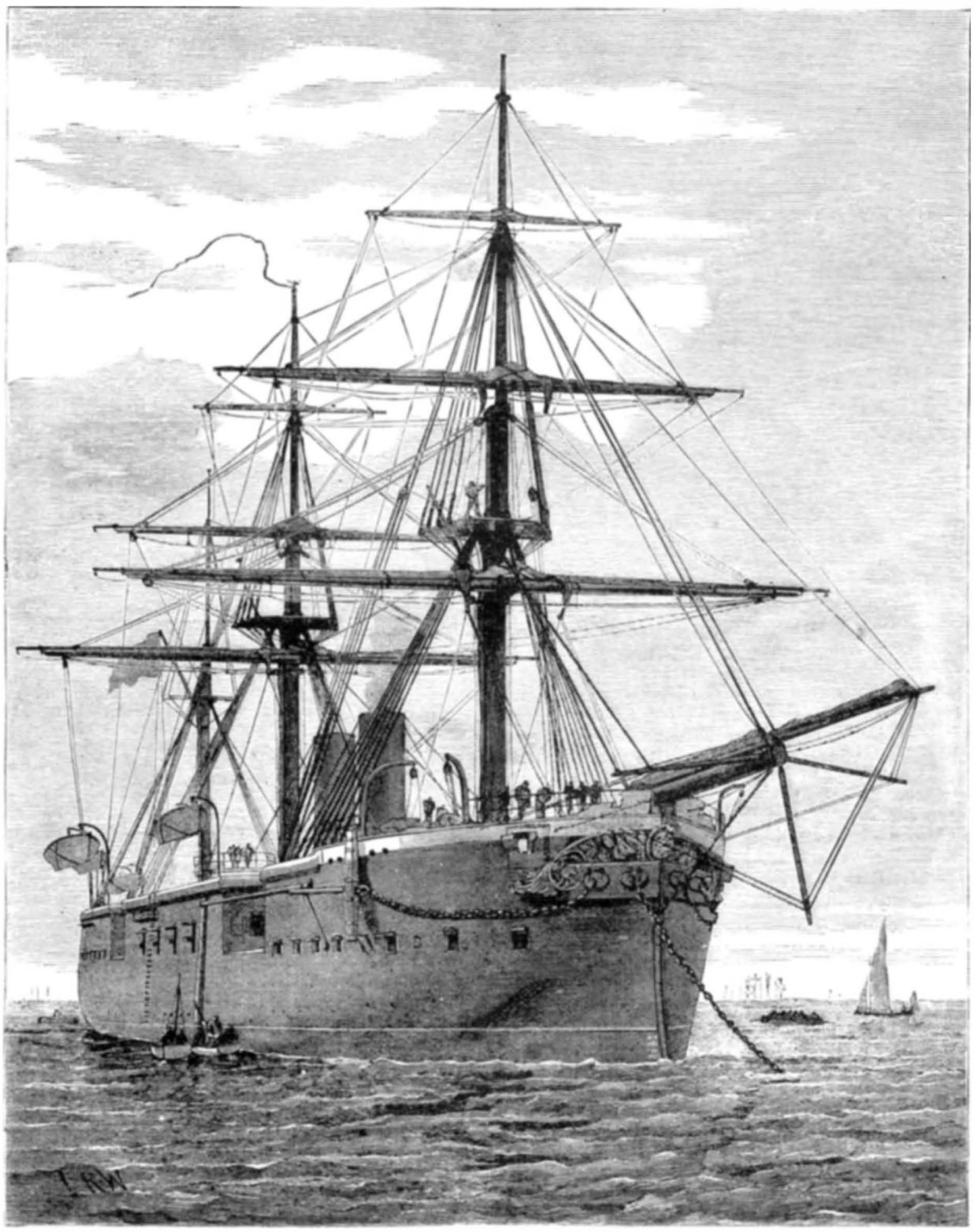
NEW TURKISH IRONCLAD.

Our engraving represents one of the two largest ironclads now possessed by Turkey, the vessels being sister ships in every particular. The present craft was originally called the Memdonhiyeh, but has recently been re-named as above in honor of the present Sultan Abdul Hamid. The Hamidieh was designed by Ahmed Pasha, chief naval constructor of the Turkish Government, and was built at the Thames Iron Works, London, England. Her dimensions are: Length, 332 feet; breadth, 59 feet; depth, 19 feet; displacement, nearly 9,000 tons. The hull is divided into 71 watertight compartments. A belt of armor plating 12 inches thick, backed by the same thickness of teak, surrounds the vessel. The maindeck battery has plates of similar thickness, and is 148 feet in length, containing twelve 18 ton guns. Four corner ports are so placed at an angle that their guns may be fired astern or ahead. The upper deck armament consists in two 6½ ton guns.

The engines, built by Maudslay, Sons, & Field, are of the usual type peculiar to that firm. There are two piston rods to each cylinder connected by an inclined crosshead, one rod passing over, the other below, the crank shaft. The two steam cylinders are each 116 inches in diameter, with strokes of 4 feet. The screw is 23 feet in diameter, with 19½ feet pitch. There are eight boilers, with 22,500 feet of heating surface. Tests of this vessel on the measured mile gave: Revolutions, 66·3; vacuum, 26½; boiler pressure, 28½ lbs.; speed, 13·74 knots. The ship at last accounts was in England, but is expected to go into active service on the Black Sea.



THE TURKISH IRONCLAD HAMIDIEH.

Investigations on the Gastric Juice.

M. Richet, according to the *Répertoire de Pharmacie*, has been enabled to institute a series of experiments on this subject under singularly favorable circumstances. A young man came before him on whom, in consequence of incurable stricture of the œsophagus, gastrotomy had been performed, and a permanent gastric fistula had been established. The œsophagal stricture being complete, swallowing was of course impossible, so M. Richet was enabled to procure the gastric juice without any admixture of saliva. He finds the average proportion of hydrochloric acid to amount to 0·17 per cent, the proportion being increased by wine and alcohol, but diminished by sugar. The ingestion of acids or alkalies made little difference, as the normal proportion was soon restored. The acidity of the gastric juice is increased during the process of digestion, especially towards its close. The sensations of hunger and thirst are in no way associated either with gastric acidity or with the state of the stomach as to emptiness or repletion. Ordinary kinds of food occupy three to four hours in digestion; but milk takes only half this time, while all traces of water or alcohol disappear from the stomach in about three quarters of an hour. M. Richet has availed himself of this favorable opportunity for the purpose of investigating the nature of the free acid in the stomach, and hopes shortly to publish his researches on this subject.

The Nebulæ—What are They?

Mr. E. J. Stone, M.A., F.R.S., Her Majesty's Astronomer, Cape of Good Hope, says, in a paper recently read before the Royal Society:

"Before the announcement of Mr. Huggins' discovery of the presence of bright lines in the spectra of nebulæ, it was generally, if not universally, accepted as a fact that nebulæ were merely stellar clusters irresolvable on account of their great distances from us. This view had become impressed on the minds of many of our greatest observing astronomers in the progress of their work, and is one therefore which should not lightly be abandoned. It appears to me that Mr. Huggins' observations instead of being inconsistent with the view formerly held by astronomers, are rather confirmatory of the correctness of that view.

"The sun is known to be surrounded by a gaseous envelope of very considerable extent. Similar envelopes must surround the stars generally. Conceive a close stellar cluster. Each star, if isolated, would be surrounded by its own gaseous envelope. These gaseous envelopes might, in the case of a cluster, form over the whole, or a part of the cluster, a continuous mass of gas. So long as such a cluster was within a certain distance from us the light from the stellar masses would predominate over that of the gaseous envelopes. The spectrum would therefore be an ordinary stellar spectrum. Suppose such a cluster to be removed further and further from us, the light from each star would be diminished in the proportion of the inverse square of the distance; but such would not be the case with the light from the enveloping surface formed by the gaseous envelopes. The light from this envelope received on a slit in the focus of an object glass would be sensibly constant because the contributing area would be increased in the same proportion that the light received from each part is diminished. The result would be that at some definite distance, and all greater distances, the preponderating light received from such a cluster would be derived from the gaseous envelopes and not from the isolated stellar masses. The spectrum of the cluster would therefore become a linear one, like that from the gaseous surroundings of our own sun. The linear spectrum might, of course, under certain circumstances, be seen mixed up with a feeble continuous spectrum from the light of the stars themselves.

It should be noticed that, in this view of the subject, the linear spectrum can only appear when the resolvability of the cluster is at least injuriously affected by the light of the gaseous envelopes, becoming sensibly proportional to that from the stellar masses, and that in the great majority of such cases it would only be in the light from the irresolvable portions of the cluster that bright lines could be seen in the spectrum.

"The changes in form which would be presented to us by such a nebula might be expected to be small. These changes would depend chiefly upon changes in the distribution of the stellar masses constituting the cluster. It has always appeared to me difficult to realize the conditions under which isolated irregular masses of gas, presenting to us sharp angular points, could exist uncontrolled by any central gravitational mass without showing larger changes in form than appear to have been the case with many of the nebulæ. In my view of the nature of nebulæ this difficulty no longer exists."—*Nature.*

Cutting Down Trees by Electricity.

A few years ago, a Dr. Robinson, of New York city, took out a patent through the Agency of the SCIENTIFIC AMERICAN, for felling trees by means of a platinum wire, in place of the axe or saw, using an electric battery for the severing power, by keeping the wire at a white heat and drawing it back and forth, and keeping it taut to the tree as it penetrated the trunk. We published an account of the invention at the time the patent issued, which elicited considerable attention from all parts of the world. According to the *Lumberman*, an experiment with the same invention has recently been tried in the East Indies, from which our contemporary quotes from a local paper, published in that country. The paper states that the patentees of the process are Mr. H. H. S. Parkinson and Mr. W. H. Martin, both of Bombay; and the experiment was superintended by Dr. Lyons. The plan is simple. The two ends of the copper wires of a galvanic battery are connected with platinum wire, which of course instantly becomes red hot, and while in that state it is gently seesawed across the trunk of the tree to be felled. When arrangements were made for the experiment, it was never for a moment doubted that the enterprising merchants of Bombay were possessed of all its made thicknesses of platinum wire, but it turned out that the thickness of the thickest that could be got was only that of crochet cotton. It was at once seen that a wire of such thinness would be consumed before the tree was half severed from its trunk. However, the attempt was made. The burning wire performed its task very well so long as it lasted, but, as anticipated, the wire continually broke, and at length there was none left. There can be little doubt that with a stronger battery—the one used was only a twelve-chambered one—and a thicker wire, the experiment would have been entirely successful. As it was, the tree was sawed one fifth through. It is calculated that, under proper conditions, a tree, which at present takes two hours to fell, will come to the ground by this process in fifteen minutes. It is almost needless to add that there is no waste of wood and no sawdust.

Propagation of Heat.

We learn from the *Répertoire de Pharmacie* that M. Olivier has found that under certain circumstances heat is not propagated by direct proximity. His experiment was thus conducted: A bar of steel of certain dimensions being selected, the operator places one hand over the center of the bar and the other over one of the extremities. The other extremity is then heated by rapid friction with energy. At the end of a few minutes the further extremity of the bar becomes so hot as to compel the operator to remove his hand, while his other hand, which had been placed over the middle of the bar (and, consequently, nearer to the extremity warmed by friction), perceives no heat whatever.

TO BORE a hole easily through a hemlock knot, wet your auger in turpentine.

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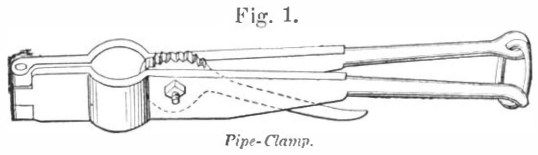
PIPE TOOLS.

The implements represented in the annexed engravings (from Knight's "Mechanical Dictionary,"*) all relate to the manipulation of pipe. Fig. 1 is a pipe holder having a simple

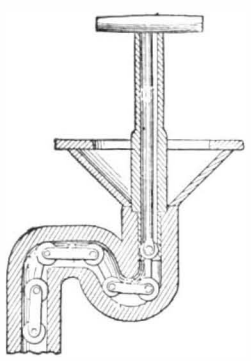
Fig. 1.



Pipe-Clamp.

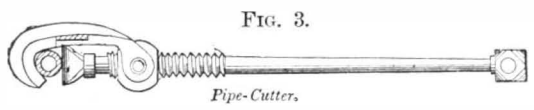
corrugated cam clamp, whereby the work is tightly held. Fig. 2 is an implement for pushing obstructions out of bends in pipe. A force pump is usually employed for this purpose; but, in some cases, a jointed thrusting implement, such as that illustrated, becomes necessary. Fig. 3 represents a pipe cutter in which a movable jaw is hinged to a nut which traverses the threaded shank, and operates in opposition, either to the socket end of the shank or to a cutter inserted therein. Figs. 4, 5, and 6 illustrate three other forms of this implement. Fig. 4 is a tool with three revolving cutters, so set that two cutters are in the body of the tool, and one adjustable cutter is held by a movable wrought iron

Fig. 2.



Pipe-Clearer.

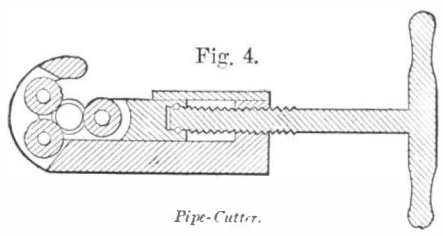
Fig. 3.



Pipe-Cutter.

stock. Fig. 5 represents a tool in which a sharpened disk within a block is fastened to the end of the screw rod; and

Fig. 4.



Pipe-Cutter.

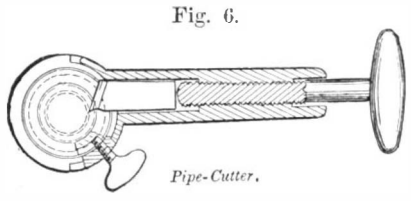
the pipe, being clamped between the disk and the hook, is cut by turning the instrument around the pipe. In

Fig. 5.

Pipe-Cutter.

Fig. 6 the tube and its bushing are made to encircle the pipe; and the cutter is forced into the side of the pipe by

Fig. 6.

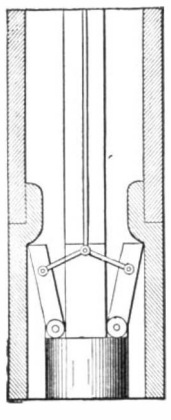


Pipe-Cutter.

turning the screw. The pipe is then severed by turning the instrument around upon it.

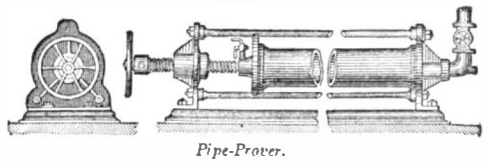
Fig. 7 is a tool which is let down into a well pipe in order to hoist the latter to the surface. It consists simply of wedges on the head of the draw rod, which are expanded and caused to grasp the tube after being inserted to the proper depth. Fig. 8 is an apparatus for proving steam or water pipes by hydraulic pressure. It consists of a metallic bed plate (on which are fixed two cast iron head stocks connected by strong wrought iron bolts), a cast iron follower with square thread screw, and a hand regulating wheel, screw water valve, and air cock; also a gun metal pressure pump, inclosed in an iron cistern, and a pressure gauge. The method of using the apparatus is as follows: The pipe is placed between the head stocks in contact with rubber rings, and the joints are made by screwing up the follower by means of the hand wheel. The pipe is rapidly

Fig. 7.



Pipe-Grab.

Fig. 8.



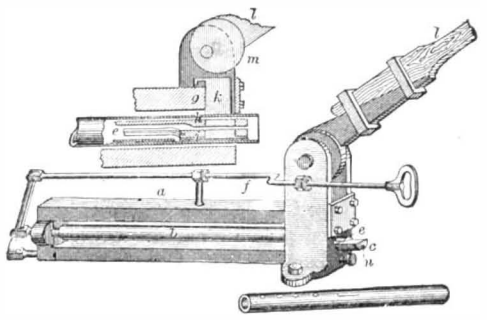
Pipe-Prover.

filled with water from any convenient source above the machine by opening the water valve, when the proof pressure may be applied by the pump.

* Published in numbers by Messrs. Hurd & Houghton, New York city.

Fig. 9 is a machine for punching holes or slots in metallic tubes, consisting of a frame, *a*, in which is fixed a strong hollow mandrel, *b*. A semicircular wedge, *c*, is fitted into the mandrel and connected by a rod, *e*, to a lever at the other end of the machine operated by the rod, *f*. The frame, mandrel, and wedge are slotted at *g h i*, forming a series of openings through which the punch, *k*, may work. In using the apparatus, the pipe is slipped over the mandrel, and by forcing the rod, *f*, inward, the wedge, *c*, is caused to enter the pipe and resist its tendency to be bulged inwardly under the action of the punch. The lever, *l*, is depressed, operating the eccentric, *m*, and forcing the punch through the

Fig. 9.

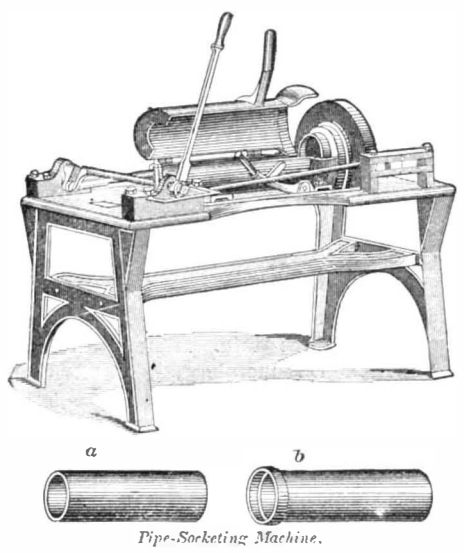


Brigden's Pipe-Slotting Punch.

upper side of the pipe; the piece of metal cut out is driven through the aperture, *h*, in *i*. An upward movement of the lever, *l*, permits a spring to lift the punch, and the rod, *f*, is pushed inward to withdraw the wedge, after which the pipe may be removed. By a reverse movement of the rod, a small projecting pin on the frame, *a*, is caused to push the chip cut from the pipe out through the longitudinal slot, *n*, in the wedge.

In Fig. 10 is represented a machine for finishing the moulding process of clay or concrete pipes by making a socket on one end to receive the smaller end of an adjacent pipe when laid; *a* shows the pipe before socketing; *b* after-

Fig. 10.

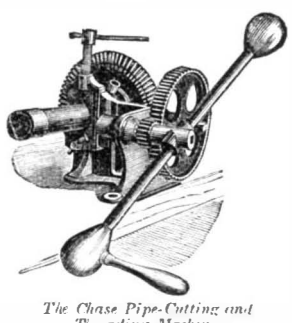


Pipe-Socketing Machine.

wards. The pipe, *a*, is placed in the bed of the machine, and the upper clamp brought down and locked. The headpiece, which has the counterpart form of the socket, is then brought forward by the lever, expanding the clay into the shape of the former.

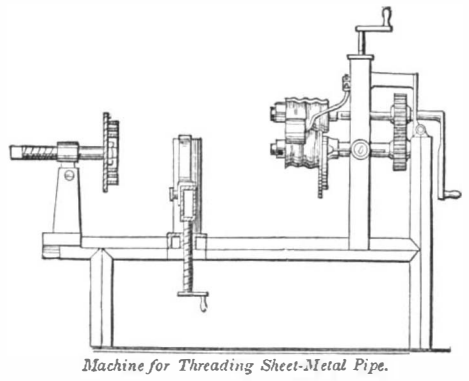
Fig. 11 is a machine of the nature of a screw stock to cut a thread on the end of a wrought iron pipe. It is fitted for hand power, motion being transmitted to the several parts by means of gearing; the pipe is shown projecting toward the left, and is held stationary by the adjustable jaws of the pipe vise. The pipe passes through the center of the gear wheel, the rotary motion of which is imparted to the die in the die box by means of studs or guides upon which the die box freely slides forward as the die passes upon the pipe.

Fig. 11.



The Chase Pipe-Cutting and Threading Machine.

Fig. 12.



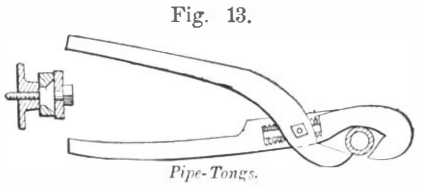
Machine for Threading Sheet-Metal Pipe.

When cutting pipe, the tool post with the cutter has automatic feed, cutting the ends of the pipe squarely and smoothly.

Fig. 12 is a machine in which sheet metal pipe is passed between the two rotating circumferentially ribbed cylinders, the ribs of the cylinders meshing together. As the cylinders rotate they impress the thread upon the pipe.

Fig. 13 represents a pair of tongs with one short jaw

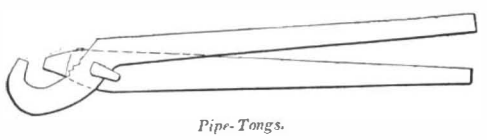
Fig. 13.



Pipe-Tongs.

adapted to grasp a pipe or rod. Their range of grasp is but limited, and a number are provided for varying sizes of pipes.

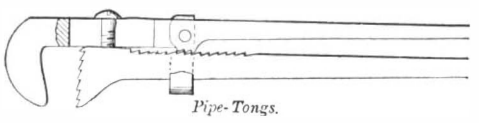
Fig. 14.



Pipe-Tongs.

Their grasp is more tenacious than that of a monkey wrench. Varieties of the implement are illustrated in Figs. 14 and 15.

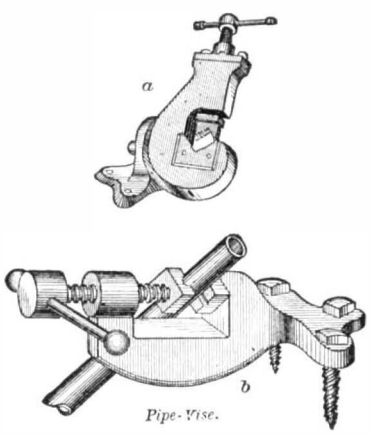
Fig. 15.



Pipe-Tongs.

Fig. 16 is a pipe vise or implement for holding a pipe while being threaded or otherwise fitted; *a* and *b* are different patterns, both for bench use.

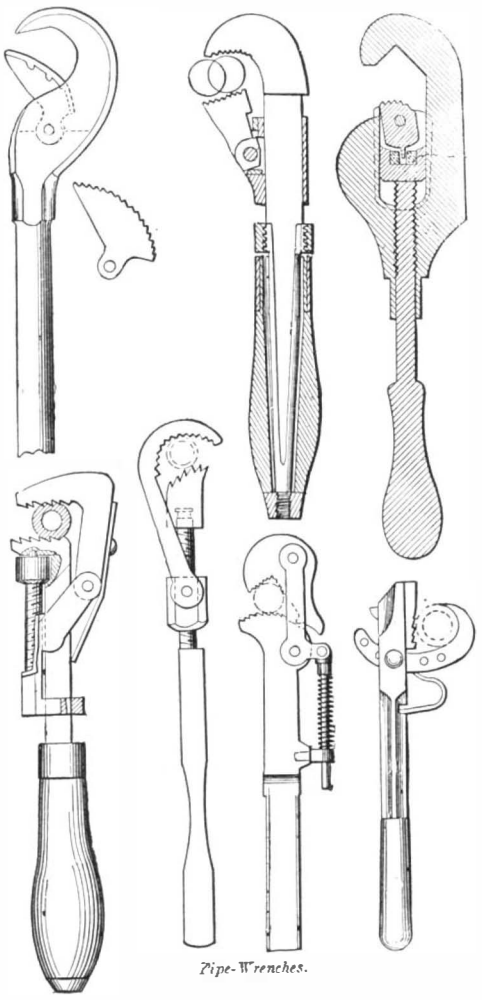
Fig. 16.



Pipe-Vise.

Various forms of pipe wrenches are illustrated in Fig. 17. The instrument is usually made with a movable and a relatively fixed jaw, so arranged as to bite together when

Fig. 17.



Pipe-Wrenches.

they are made to grip the pipe, and are revolved in a certain direction around it. The figure shows several kinds, which will be understood without specific description.

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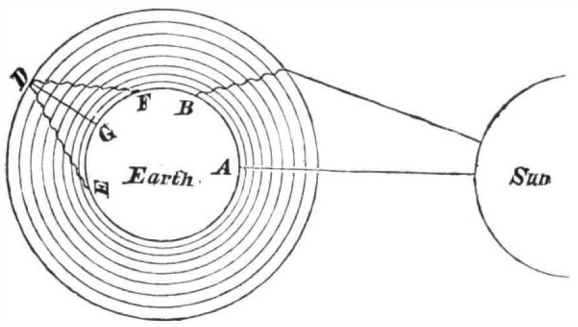
Communications.

The Undulatory Theory of Light.

To the Editor of the Scientific American:

Permit me to submit the following for the purpose of reconciling the undulatory or wave theory of light to that of the straight-line theory of Sir Isaac Newton.

Let the inner circle represent the earth, the outer circle the exterior surface of the earth's atmosphere, and the inner lines the lines of temperature of the atmosphere. An observer, standing on the earth at A, at the moment when that portion of the earth was nearest to the sun, would notice that light travels in a straight line. An observer at B would witness



the undulatory or the wave motion of the light passing in an oblique direction through the various degrees of temperature of the earth's atmosphere. A light at D would travel in a straight line to G; but it would be seen traveling in waves, if an observer were at E or at F. In like manner, sound would travel in waves from E to F, but in straight lines from D to G, and in waves from D to F, D to E. It seems to me that both theories are correct. One of the two may be the general rule, and the other the exception.

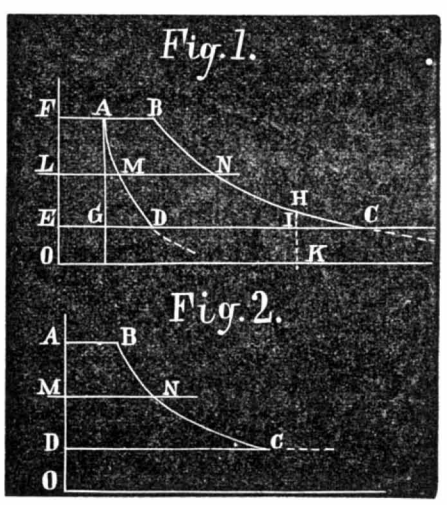
Montreal, P. Q. DUGALD MACDONALD.

Steam Economy Computations.

To the Editor of the Scientific American:

Your correspondent of Salem, Ohio, speaks in your issue of May 26 of "the proper allowance for clearance and compression" in steam engine cylinders. If the allowance referred to is for securing the highest percentage of useful effect from the steam used, the method indicated for making that allowance differs from at least one authority, which is regarded by many as the very highest on the subject of steam engineering, namely, Rankine "On the Steam Engine." On page 420 of this work, it says: "In order to represent the *most advantageous adjustment* of the compression, the quantity of steam confined or cushioned is *just sufficient to fill the clearance at the initial pressure.*" No demonstration of this is given in the work, as applying directly to this problem; but from principles set forth in the chapter, it can readily be shown to be correct. It may also be made plain by the aid of diagrams, Figs. 1 and 2. Let O E, Fig. 1, represent the atmospheric pressure, O F the absolute pressure of admission, G C the stroke of the piston, and E G the clearance, such that, if G C is the volume of the cylinder, E G is the volume of the clearance: A will then be the initial position of the piston, B the point of cut-off, B H C the curve of expansion, and A D the curve of compression. The indicator diagram will then be A B C D A.

Many assume the curve, B H C, to be a common hyperbola, with O F and O K as asymptotes; but both the theoretical and actual curves differ considerably from it. But whatever it be, it is evident that the operations going on in describing



B C are simply repeated, in the reverse order, with a less quantity of steam, in D A. From this it appears that any horizontal line, L N, is cut by the curves in such a manner that FA:FB::LM:LN::ED:EC, etc.; or we may put it: AB:FB::MN:LN, etc.

Now if the piston could start from E F, the engine would virtually have no clearance; and the indicator card would be F B C E F. All engineers would say that this diagram has no loss due to clearance. But when the piston starts from A G, the diagram is A B C G A, the compression being suppressed, and the clearance supposed to be A F E G. The same steam is used as before; but the work done is less than before, in proportion to the decrease, A F E G, of card area. In other words, a diagram indicating no loss due to clearance should have its back line stand in the same relation to the expansion curve as E F does to B C; and A G is not thus conditioned. But the above proportions show that A D would be thus conditioned, if A D and B C could be so modified as to make A D vertical, and preserve the horizontal secants, M N. On another set of right-angled axes, we may do this by laying off A B, M N, etc., as indicated in Fig. 2: when we get a card shorter, but the same in kind exactly, as F B C E, Fig. 1, already shown to be free from clearance loss. Hence, when an engine must have clearance, it can only be compensated for by cushioning in such a manner that the terminal pressure of compression equals the initial admission pressure. The above discussion supposes that the expansion is carried to C; but if the release occurs at H, there will be a loss, H C I, due to earlier exhaust. If the release line, H I, could be made parallel to D M, the corresponding line in Fig. 2 would be vertical, giving the same kind of a diagram in Fig. 2 as E F B H I E, Fig. 1, and as good as is obtainable from an engine without clearance and a square release line.

In designing common D slide valves of engines, the clearance, A F, should be known, so that the point, D, may be found; G D being greater, evidently, as A F is greater. The practical effect of giving large clearance, and hence early cushioning, is to increase the inside lap of valve, increase the angular advance of eccentric, and increase the expansion by making the cut-off earlier. With a clearance of a tenth or twelfth of the cylinder volume, the cut-off may be brought back to half-stroke with all the other points favorably conditioned.

S. W. ROBINSON,
School of Mechanical Engineering, Illinois Industrial University.

Fast and Slow Grinding.

John M. Truax, a prominent and practical New England miller, in a recent communication on the above subject, writes as follows:

"I have heard and read a great deal about slow and fast grinding, and how to dress and how not to dress a mill, etc., etc. Many good millers have related their experience, and made elaborate arguments to prove their theories, and have done much to enlighten their brethren in the milling science, all of which is commendable. But to say who has hit the nail on the head would be hard to tell. If the nail has been hit, who has counted the effect of the blow? To my mind, the reasons given for fast or slow grinding have not been shown. The quantity to be ground must depend upon the texture or density of the stone, the draft, the number and depth of furrows, and the grinding without heating. No more grinding should be done than can be done without heating. The heating is the stopping spot. The quantity that every mill ought to grind is that quantity that can be ground and not heat, whether it is 5, 10, or 20 bushels per hour. If every miller will observe this as his guide, he will do the best work that he is able to do.

"In speaking of heating, I mean to say that the grain should not be so heated by pressure or rubbing, as will start the juice or essential oils of the grain. If the grain oil is started by friction, that friction produces heat, and that heat dries and evaporates the grain juice, and the virtue of the flour is impaired. Any amount of cooling will not repair the damage done by heating. The steam that rises from the hot running mill is the vapor from out of the essential oils of the grain, and is lost in the bread. To recommend the grinding of 10, 15, or 25 bushels of wheat per hour is bad advice, imprudent. Millers differ in the selection of stones, and differ about their dress and the motion of their mill. One will have one kind and way, and another another kind and way; but whatever way they select, when they go to grinding, their quantity per hour should be that which they can grind and not heat, whether it is 3, 5, 10, or 20 bushels per hour. Do not impair the substance for the bulk per hour. Blood heat is as high as can be warranted without impairing the product. It may be an ambition to grind fast, but an old adage is 'haste makes waste.' If millers are ambitious, let that ambition be applied to the making of a perfect running mill. Select the very best buhrs, and put in a thoroughly common-sense dress, a dress that will granulate the whole kernel as nearly as possible. Keep the stones as far apart as possible, and keep the texture or grain of the stones clean. Let this be the miller's ambition. But stop adding to quantity when the mill is at blood heat, and let the breadmakers and eaters have in their flour all the virtue that Mother Earth has produced.

"One of the great evils in milling is low grinding, and its evil effects are only second to those produced by fast grinding. Wheat is composed of two parts—an inner and an outer part. The inner part is meaty, and the outer is a shuck, or skin, or hull; the meaty is pulverizable, while the hull or covering is a leather-like substance, and has thickness, which thickness equals the meshes of No. 14 or 15 bolting cloth. Now, the question arises, how shall the miller grind this compound kernel and clean this leather-like covering, and granulate the inner meat to a proper fineness for bread purposes, and not over-rub or grind to dust a part of the hull? This is the question. And how is wheat being ground all over the world to-day? I need not answer, for all know that heavy grinding has been the order. The lands or faces of one buhr rub the other, or nearly so. So much so that that portion of the bran which is caught between the face of the mill near the skirt is more than twice overground, and this overgrinding or rubbing the bran makes a brown dust, and blackens the flour. It is like brown paint, and bolts with the flour and goes into the bread.

"This is a mistake, and should be avoided. Bran may make bread, but not the bread millers feel proud of. And to avoid this, millers must run a light mill. Heavy grinding is an evil. It not only powders a portion of the bran and blackens the flour, but grinds at the same time a portion of the kernel to dust, also destroying its juicy substance; and at the same time the fine ground dust is rubbed into the texture of the stone, and the face of the stone becomes glazed and smooth, and of course dull.

"Millers, so dress your mill as will enable you to grind the inner part of the kernel to flour, and avoid making brown paint dust from the bran. A miller that runs a heavy mill is like to look for a medicine to doctor his flour. Medicine for flour is a poor substitute for a good dress and clean stones. Bread-eaters much prefer the full life of the cereals, not a doctored article. Grain once killed by overgrinding and heating will not be brought to life by the best medicines. All the flour doctors in the world cannot repair the life that is first produced in natural growth. They may help a deadened flour, but a whole reparation is impossible. Throw away the dregs! Let us have a pure flour."—*Mill Stone.*

Production of Salt in England.

Of the many minerals raised in the kingdom few play a more important part, or are less noticed, than that which is found in every household throughout the land—salt. It is an essential that we could not dispense with, not only as a culinary ingredient, but in many other ways. Our resources, too, are such that they have not only been fully equal to the wants of our own population, but we have been able to spare yearly from 200,000 to 250,000 tons to other countries that are not so favored as ourselves. There are districts in many parts of the country where salt could be met with were such necessary, for, some time since, whilst boring near Middlesborough, in the expectation of meeting with the coal measures, rock salt was met with at a depth of 1,800 feet. At the Moira Colliery, near Ashby-de-la-Zouch, in Leicestershire, at a depth of 593 feet, salt water, beautifully clear, trickles down from the fissures where the coal is being worked. The brine is taken to Ashby, and has been in good repute for rheumatic and other complaints. As to the origin of salt, there are many theories, but it may be stated that in nearly all substances, wherever found, it is in the new red sandstone. By many it is believed that the formations are due to the evaporation of the water from inland salt lakes or parts of the sea severed from the main body of the ocean by volcanic action, the evaporation causing the deposit of the salt held in solution by the sea. Writing more recently on the subject of the great European salt deposits, Mr. T. Ward propounds a rather different theory. He considers that the salt deposits owe their origin entirely to the elevation of the mountain chains with which they are so intimately connected, during which small valleys and ravines would be cut off from connection with the sea by ridges of land, and would form salt lakes and lagoons. Cheshire is still the main source from which we draw our own supplies, and export to the United States, Russia, and other countries. There we have had considerable landslips in working it, but there are the red rocks showing keuper or saliferous marl, with thin beds of limestone, and then 200 feet of rock salt. In Worcestershire, at Droitwich and Stoke Prior, the salt is made from brine alone. A large proportion of what is made at Norwich, Middlewich, and Winsford, in Cheshire, is sent down the river Weaver, the quantity in 1857 having been 772,175 tons, and in 1866 it had increased to 1,118,991 tons. During the last 20 years, however, the increase in the production has been of a most marked character, whilst the price has gone down very much. In 1855 the salt raised in the kingdom was 1,094,770 tons, the average price at the works being about $6 per ton. In 1875 there was raised 2,316,644 tons of salt, the price being barely $3.60 per ton. The value of the salt exported in 1855 was $1,738,570, and in 1875 it was only $860,255, when our exports were 916,468 tons, or nearly as much as the entire produce of the kingdom in the former year. Our principal customers include the United States, British India, British North America, and Russia. From the figures given it will be seen that nearly 40 per cent of the salt produced in the kingdon is exported to other countries.—*Mining Journal.*

GAUGES.

Since the introduction of special machines and tools designed to produce and reproduce the various parts in quantities, and of exactly uniform size and shape, the importance of standard gauges has been greatly increased; and in establishments where this system is followed, the best of skill and the greatest of care and watchfulness are necessary to maintain the exact standard. It is obvious that, when the various parts of a piece of mechanism are made separately in large quantities, and are not assembled until the whole are finished, a slight variation of size or form would soon impair the fit of the various parts, and therefore the value of the whole system. Now, theoretically, a new tool decreases in size from the moment it commences to perform cutting duty until it is worn out; and the point at which the wearing-out process may have arrived at its greatest permissible limit is, under light duty, more often determined by the reduction of its size than of the loss of its keenness or other cutting properties. Many firms prescribe a definite permissible limit of wear to certain tools, such as the one thousandth or two thousandth of an inch, and make two sets of gauges, one of the precise size and the other showing the extreme

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limit to which the range of size is permitted; and when that limit is reached, the tool maker or foreman is notified that the tool may be restored to its standard. For the purpose of this restoration a standard gauge is required; and this gauge even is subject in some degree to wear, especially if it be not handled with extreme delicacy. No more delicate proof of this fact can be shown than in the following: If we take a pair of cast iron surfaces, having an area of 100 inches, and clean them thoroughly with alcohol, and then, after freely lubricating them with the best sperm oil, rub one a few strokes upon the other, we shall find that (though, from the existence of the oil, neither the eye nor the sense of feeling gives the least indication that the surfaces have had the least contact) still the oil will have become so darkened, or rather blackened, in color as to clearly demonstrate that abrasion has, to some practical extent, taken place. From this we may perceive that, in trying hardened steel tools with gauges, the latter, though of hardened steel themselves, may very easily become worn if rudely handled.

The gauges used as standards for male and female cylindrical forms are usually after the pattern shown in Figs. 1 and 2. They are made of steel; and after being hardened they are ground to size, the grinding process being so delicately performed as to leave a polish. In testing such gauges the

Fig. 1.

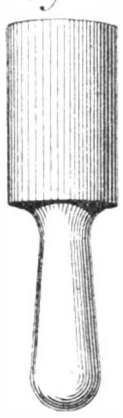
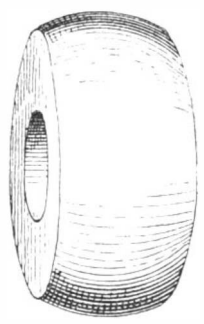
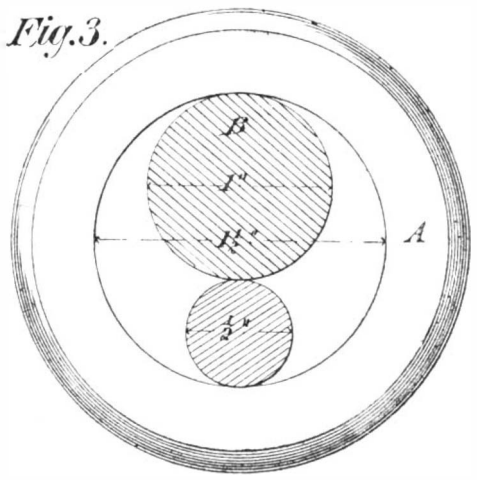


Fig. 2.



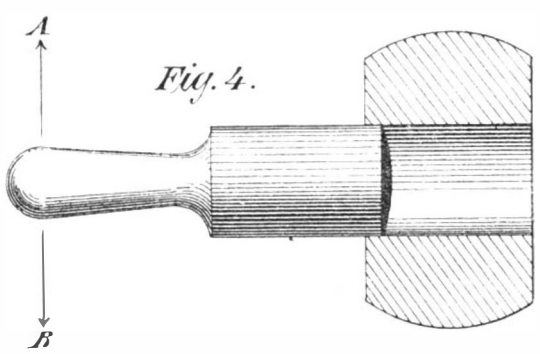
heat imparted to them by holding them for any length of time in the hand will cause a perceptible difference in the size; hence, to insure the greatest practicable accuracy, it is necessary to test the whole set at an equal temperature. As a test of accuracy, we may take a female gauge and place therein two or three male gauges, whose diameters added together will equal that of the female. Thus in Fig. 3, the

Fig. 3.



size of the female gauge, A, being 1½ inches, that of the male, B, may be 1 inch, and that of C ½ an inch, and the two together should just fit the female. On the other hand, were we to use, instead of B and C, two males, ⅞ and ⅝ inches, respectively, they should fit the female; or a ½ inch, a ⅝ inch, and a ⅜ inch male gauge together should fit the female. By a series of tests of this description, the accuracy of the whole set may be tested; and by judicious combinations, a defect in the size of any gauge in the set may be detected. A notable fact with reference to these gauges is that, if we take a male and female of corresponding sizes, and slide the one continuously through the other, it will pass through at a

Fig. 4.



proper fit; but if we arrest the progress of the male and allow it to rest a few moments, it will become fast in the female and require considerable force to remove it again. The wear of these gauges takes place most rapidly at and near the ends, because it is difficult in using them to keep them in lines true with the bores into which they are tried; and the movement due to the adjustment to line causes abrasion. It is indeed an excellent method of testing to place one in the other to the depth of about $\frac{1}{16}$ of an inch, as shown in Fig. 4; and holding the female firmly, lightly press the male first in the direction of A and then of B. There are few gauges which will not, under such a test, show some slight movement, denoting defect.

Solid cylindrical tools are often made of steel wire drawn to gauge, and to great accuracy of diametrical size. There is, however, a slight degree of variation due to the wear of the drawing dies. In the table below will be found the gauge numbers, and the sizes in decimal parts of an inch of the celebrated Stubs wire. The first column is the size according to the Stubs wire gauge; the second is the size in decimal parts of an inch, as given by Mr. Stubs; and the third column represents the average sizes obtained from actual measurements of the wire, taken during a period of several years by the Morse Twist Drill and Machine Company, whose drills are made to great diametrical accuracy.

DIAMETER OF STUBS' STEEL WIRE IN FRACTIONAL PARTS OF AN INCH.

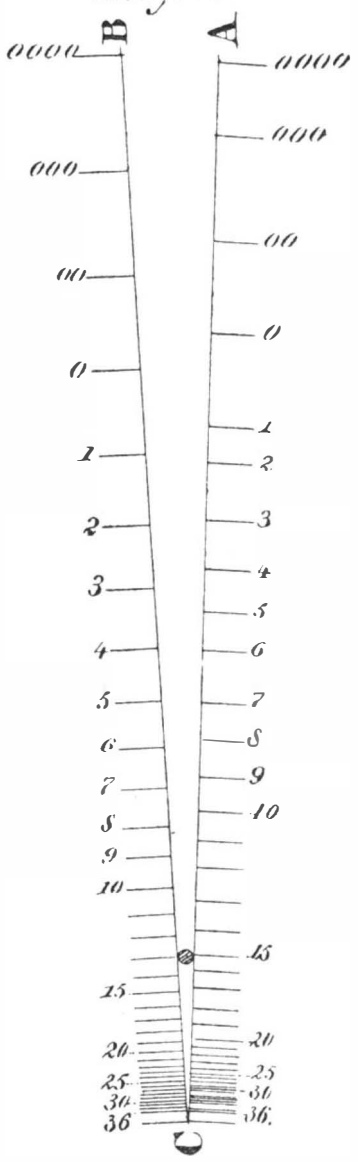
No. by Stubs' Wire Gauge.	Stubs' Dimensions.	Measurement by Morse Twist Drill and Machine Co.	No. by Stubs' Wire Gauge.	Stubs' Dimensions.	Measurement by Morse Twist Drill and Machine Co.	No. by Stubs' Wire Gauge.	Stubs' Dimensions.	Measurement by Morse Twist Drill and Machine Co.
1	0·227	0·228	23	0·153	0·154	45	0·081	0·082
2	0·219	0·221	24	0·151	0·152	46	0·079	0·080
3	0·212	0·213	25	0·148	0·150	47	0·077	0·079
4	0·207	0·209	26	0·146	0·148	48	0·075	0·076
5	0·204	0·206	27	0·143	0·145	49	0·072	0·073
6	0·201	0·204	28	0·139	0·141	50	0·069	0·070
7	0·199	0·201	29	0·134	0·136	51	0·066	0·067
8	0·197	0·199	30	0·127	0·129	52	0·063	0·064
9	0·194	0·196	31	0·120	0·120	53	0·058	0·060
10	0·191	0·194	32	0·115	0·116	54	0·055	0·054
11	0·188	0·191	33	0·112	0·113	55	0·050	0·052
12	0·185	0·188	34	0·110	0·111	56	0·045	0·047
13	0·182	0·185	35	0·108	0·110	57	0·042	0·044
14	0·180	0·182	36	0·106	0·106	58	0·041	0·042
15	0·178	0·180	37	0·103	0·104	59	0·040	0·041
16	0·175	0·177	38	0·101	0·101	60	0·039	0·040
17	0·172	0·173	39	0·099	0·100	61	0·038	0·039
18	0·168	0·170	40	0·097	0·098	62	0·037	0·038
19	0·164	0·166	41	0·095	0·096	63	0·036	0·037
20	0·161	0·161	42	0·092	0·094	64	0·035	0·036
21	0·157	0·159	43	0 088	0·089	65	0·033	0·035
22	0·155	0·156	44	0·085	0·086			

The following table represents the letter sizes of the same wire:

LETTER SIZES OF WIRE.

A	0·234	J	0·277	S	0·348
B	0·238	K	0·281	T	0·358
C	0·242	L	0·290	U	0·368
D	0·246	M	0·295	V	0·377
E	0·250	N	0·302	W	0·386
F	0·257	O	0·316	X	0 397
G	0·261	P	0·323	Y	0·404
H	0·266	Q	0·332	Z	0·413
I	0·272	R	0·339		

Fig. 5.



The American standard wire gauge was introduced by Messrs. J. R. Brown and Sharpe, the object being to introduce greater uniformity in the progression of the sizes. This will be clearly understood by reference to the diagram shown in Fig. 5, in which the two lines, A C and B C, meeting at C, represent the opening of an angular wire gauge. The divisions on the line, A C, show the size of wire by the common gauge; those on the line, B C, the sizes by the new American standard. Wire to be measured by such a gauge is passed into the angular opening until it touches on both sides, the line of division at the point of contact denoting the size by wire gauge number. Thus No. 13 by the old gauge is No. 15 by the new. The difference between the two gauges, known respectively as the Birmingham or English and the American, is shown in the table below:

No. of Wire Gauge.	American or New Standard. Size of each Number in decimal parts of an inch.	American or New Standard. Difference between consecutive Nos. in decimal parts of an inch.	Birmingham or Old Standard. Size of each Number in decimal parts of an inch.	Birmingham or Old Standard. Difference between consecutive Nos. in decimal parts of an inch.
0000	0·460		0·454	
000	0·40964	0·05036	0·425	0·029
00	0·36480	0·04484	0·380	0·045
0	0·32495	0·03994	0·340	0·040
1	0·28930	0·03556	0·300	0·040
2	0·25763	0·03167	0·284	0·016
3	0·22942	0·02821	0·259	0·025
4	0·20431	0·02511	0·238	0·021
5	0·18194	0·02237	0·220	0·018
6	0·16202	0·01992	0·203	0·017
7	0·14428	0·01774	0·180	0·023
8	0·12849	0·01579	0·165	0·015
9	0·11443	0·01406	0·148	0·017
10	0·10189	0·01254	0·134	0·014
11	0·09074	0·01105	0·120	0·014
12	0·08081	0·00993	0·109	0·011
13	0·07196	0·00885	0·095	0·014
14	0·06408	0·00788	0·083	0·012
15	0·05707	0·00702	0·072	0·011
16	0·05082	0·00625	0·065	0·007
17	0·04526	0·00556	0·058	0·007
18	0·0403	0·00495	0·049	0·009
19	0·03589	0·00441	0·042	0 007
20	0·03196	0·00393	0·035	0·007
21	0·02846	0·00350	0·032	0·003
22	0·02535	0·00311	0·028	0·004
23	0·02257	0·00278	0·025	0·003
24	0·0201	0·00247	0·022	0·003
25	0·0179	0·00220	0·020	0·002
26	0·01594	0·00196	0·018	0·002
27	0·01419	0·00174	0·016	0·002
28	0·01264	0·00155	0·014	0·002
29	0·01126	0·00138	0·013	0·001
30	0·01002	0·00123	0·012	0·001
31	0·00893	0·00110	0·010	0·002
32	0·00795	0·00098	0·009	0·001
33	0·00708	0·00087	0·008	0·001
34	0·0063	0·00078	0·007	0·001
35	0·00561	0·00069	0·005	0·002
36	0·005	0·00061	0·004	0·001
37	0·00445	0·00055		
38	0·00396	0·00049		
39	0·00353	0·00043		
40	0·00314	0·00039		

Fig. 6.

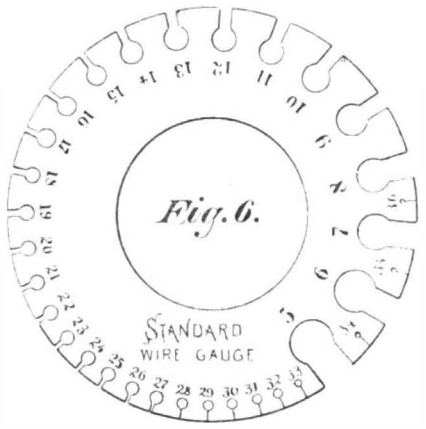
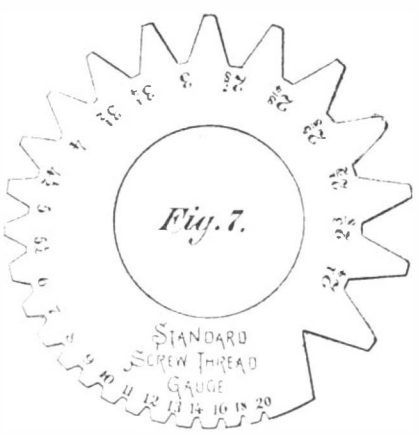


Fig. 7.



The gauge adopted by the sheet brass manufacturers of this country is shown in Fig. 6; and in Fig. 7 is shown the Franklin Institute or American standard screw gauge.

American Leather in Germany.

The United States Consul at Berlin, under date of May 1, in view of the fact that from its superior quality American leather is gradually finding its way to Germany, submits a prospectus of an exhibition of leather manufactures, to be held in that city from September 8 to 29 next. The Consul thinks an observance of the provisions of the documents would be beneficial to American interests.

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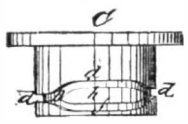
NEW FEATHERING PADDLE WHEEL.

Mr. Henry Williams, of Milwaukee, Wis., has patented through the Scientific American Patent Agency, April 3, 1877, a new paddle wheel in which the paddles or floats are feathered in passing into and out of the water. As shown in the engravings, the wheel carries a number of journaled radial arms, *b*, having at their outer extremities paddles or floats, B, which are turned through a quarter of a revolution by T levers, *c*, attached to the inner ends of radial arms, which carry a friction roller, *e*, at each end. These friction rollers move in a cam, C, of peculiar construction, which turns the T levers, and consequently the floats or paddles, at the proper instant.

Fig. 3.



The feathering part of the cam, C, is placed so that the paddles are turned at right angles to the plane of rotation as they enter the water, but are turned edgewise or parallel to the plane of rotation before they begin to rise in the water.

Fig. 1.

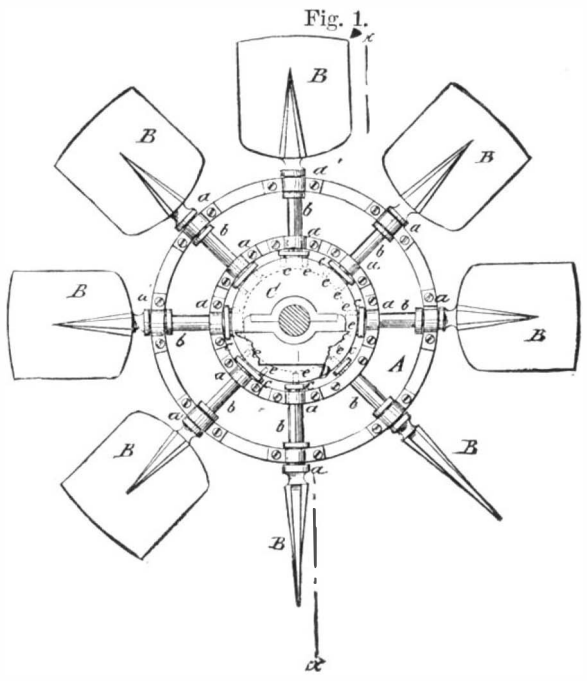
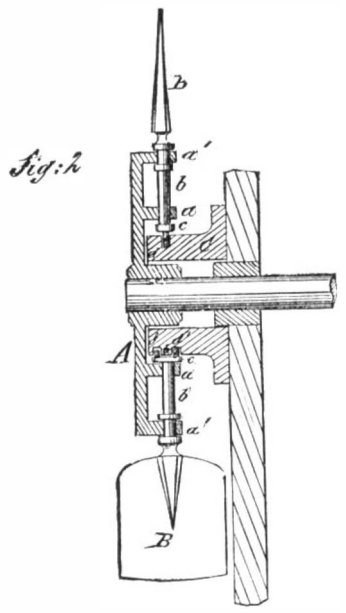


Fig. 2.



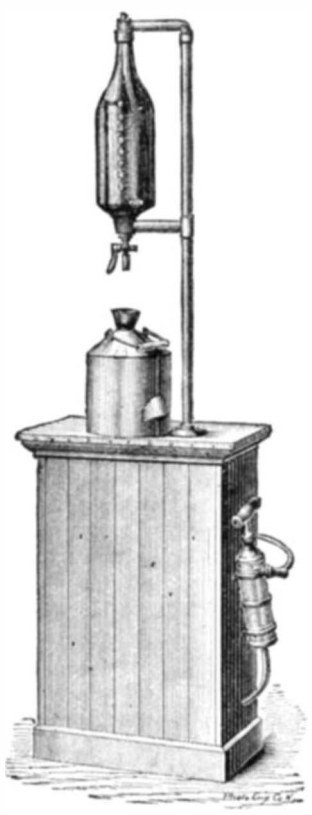
WILLIAMS' FEATHERING PADDLE WHEEL.

The Scientific American.

"THE SCIENTIFIC AMERICAN for last week contains some excellent illustrations of the great engineering work of the Delaware, Lackawanna, and Western Railroad in tunneling Bergen Hill, also a description of its progress and the expense of constructing this great addition to the railroad interests of our State, together with many other matters of interest. Mechanics and artisans, and indeed professional men generally, who desire to keep well posted in the science of mechanics, and thus attain greater usefulness in their respective professions, can make no better investment of a few dollars than by subscribing to so valuable a periodical as the SCIENTIFIC AMERICAN."—*Somerset* (*N. J.*) *Gazette.*

WILKINSON'S IMPROVED LIQUID MEASURE.

We illustrate herewith a convenient apparatus for grocers' use, designed for drawing kerosene oil in the store directly from the barrel in the cellar. It is so made that the hands need not come in contact with the oil; and it saves the time of traveling to and from the cellar whenever oil is to be drawn. At the same time, it affords an accurate means of measuring out the liquid, even to the smallest quantities; and it prevents evaporation of the same, and also chance contact with fire during handling.



The device consists of a pump, shown beside the stand in the engraving, which is connected to the oil cask by a tube which extends upward and communicates with the upper portion of a glass measure, which is marked with a graduated scale to represent gills, pints, quarts, etc. The construction is such that, when the stopcock is opened to draw off the fluid, a valve is also opened, and air is admitted to the top of the receptacle. When the measure is being filled by pumping the fluid into it, the air will open the upper valve and escape, the valve afterwards closing and preventing evaporation. The apparatus is made in any desired size and with any graduation.

Patented June 13, 1876, by Mr. J. W. Wilkinson. For further particulars, address the manufacturer, Mr. H. J. Appleby, 911 Market street, Meadville, Pa.

Science in Mexico.

We are indebted to the Hon. C. Vincente Riva Palacio, Minister of Fomento, of the Republic of Mexico, for a copy of the first volume of the *Anales* of that department. It is a very handsomely printed document of 208 pages. President Diaz has directed the publication, under the above title, of such scientific matters as the Minister may deem to be of public interest.

It would appear from this publication that President Diaz is a zealous friend of Science, and that he is disposed to do all within his power to advance the cause of scientific progress in Mexico. One of his earliest proclamations was in relation to the formation of a national astronomical observatory. The elegant palace of Chapultepec has been permanently dedicated to this purpose. A meteorological and magnetic observatory has also been provided for on the same premises. The plans for construction are practical and effective. The situation is one of the finest in the world for an observatory. Excellent lithographic plans of the projected new observatories are given, also a telegraphic map, with an account of the Mexican system of telegraphs, about eight thousand miles in extent, worked chiefly by the government. President Diaz also recently ordered a survey for a new branch canal, to facilitate the transportation of produce from the narrow country near Mexico to the railway, and Mr. Edward Davis, C.E., has surveyed an effective and economical route therefor.

Some very interesting information is given concerning the earthquakes of Jalisco, with particulars of the volcano of Ceboruco, which latter has been in a state of constant eruption since 1870. The members of the Scientific Commission established themselves for two weeks at the ranche of Uzeta, 2,000 feet distant from an approaching bank or stream of lava; and here, during day and night, they instituted observations and made surveys. With incredible difficulty they succeeded in ascending the volcanic peak and looking down into the crater, which was divided into three mouths, one of which belched forth flames and stones every eight minutes; the others poured out smoke and ashes; while two lateral streams of lava slowly flowed out sidewise from below the peak. The concluding chapter relates to the Mexican department of the Philadelphia Exhibition, gives the names of Mexican exhibitors, etc.

Value of the Scientific American.

"THE SCIENTIFIC AMERICAN, published by Munn & Co., of New York, is without a rival as a scientific paper, and to the mechanic is simply invaluable. We honestly believe any mechanic would derive information from a year's reading of the SCIENTIFIC AMERICAN which any amount of money could not buy. Some of our enterprising mechanic citizens, we hope, will try the experiment of reading this really valuable and practical journal one year. We know they would never give it up."

[Notices similar to the above (from the Glasgow *Weekly Times*) often meet our eyes in looking over our exchanges. We thank our contemporaries for their good opinion of the SCIENTIFIC AMERICAN, and wonder why the class of persons referred to above do not all subscribe and gain the benefit which they are assured would be theirs.—EDS.]

Electrical Treatment of Wounds.

M. Onimus has lately observed that the suppuration of wounds or ulcers may, by means of continuous electric currents, be increased or diminished, according to the direction of the current. The descending current, that is, when the positive pole is placed near the nerve center and the negative at the periphery, increases the suppuration, but, at the same time, the phenomena of nutrition are more considerable, and the fleshy pimples are formed with great rapidity. On the other hand, with the ascending current, the suppuration disappears very quickly. A small crust forms on the wound, which is difficult to remove, and under it there is a cicatrization.

IMPROVED MACHINE FOR SHAPING SPRINGS.

Mr. E. C. Lewis, of Auburn, N. Y., has patented through the Scientific American Patent Agency, March 27, 1877, a novel machine, which we illustrate herewith in plan and section, for automatically shaping or fitting springs in perfect and quick manner, by any unskilled workman, so as to supersede the present imperfect method of pinching the heated spring leaves or plates into form by means of tongs.

A represents a solid former, and A' a flexible former, which are both supported on a bed plate, B, the solid former being secured thereto by a screw bolt, B'. The bed plate, B, rests on suitable supporting standards, C, which carry at one side an upright arm or post, *a*, with screw cam or knuckle device, E, and at the opposite side posts, *b*, to which a solid drop, F, with handle, F^1, to operate the same, is hinged, and supported in upright position by an arm, F^2, of the bed plate. The drop block serves to straighten the edges of the plates in conjunction with the bed plate, while they are shaped by the formers. The solid former, A, may be interchanged for the purpose of shaping springs of different sizes, while the flexible former, A', is adapted to fit any size and shape of springs. The flexible former is constructed of a number of steel lugs, *d*, which are riveted to a band, *e*; or when the shaping machine is made in larger size, the lugs are connected in such a manner as to form a continuous chain, each lug forming a link. A second band, *f*, bears on the back of the first band, or directly on the connecting links of the lugs, and is attached at the ends to a rigid bow-shaped bar, G, to the center part of which a compressing screw bolt is applied. The lugs are channeled along the center, the channels running in the direction of the longitudinal axis of the former The object of the channels is to produce the instant chilling of the edges of the

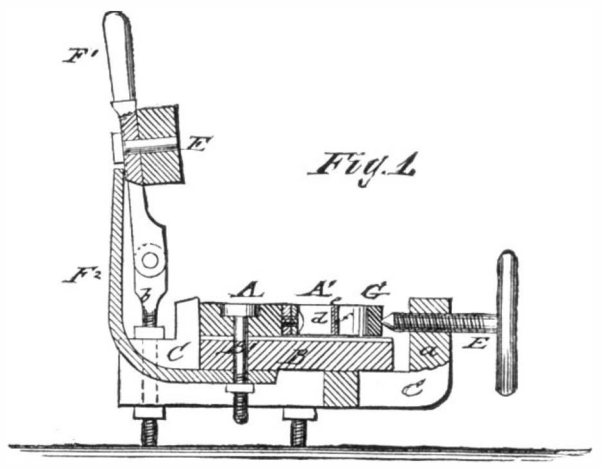
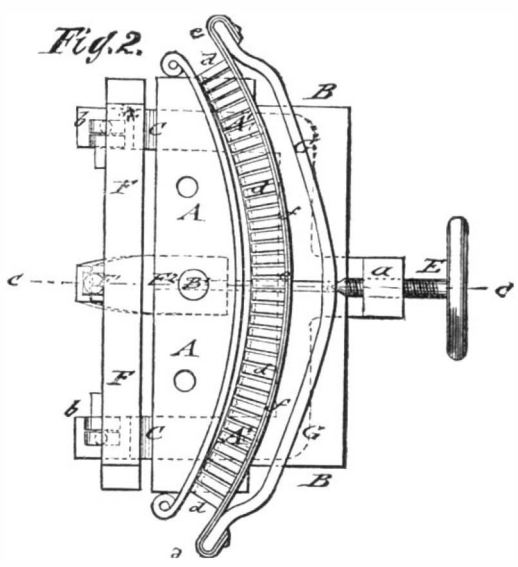


Fig. 1.

leaves or plates, while leaving them slightly warm at the center to draw down the temper somewhat. The heated plates are placed on a center pin of the solid former, and then exposed to the action of the cold formers, which are

Fig. 2.



strongly pressed together by the screw, so as to shape, chill, and temper the hot plate. The plates, when taken from the shaping machine, are ready to be bolted, and require no further manipulation.

PROFESSOR TAYLOR, of Chicago, accompanied by Lieutenant Wood, U.S.A., with all the instruments for scientific exploration, recently left Victoria, B. C., for Sitka, to make a survey of the famous snow peak, Mount St. Elias, and ascertain its altitude. It is situated 350 miles north of Sitka, and has never been ascended yet, and its height has not been determined. The result of the exploration will be reported by the department at Washington.

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PERUVIAN ANTIQUITIES.

The plateau of Ancon, in Peru, is an arid table land overlooking the sea coast and situated about 12 miles northwest of Lima. It is the location of a vast sepulchre, dating back to the earliest historical periods. Owing to the dryness of the air and the impregnation of the soil with salts, the contents of the tombs are finely preserved; and, as was apparent from the collection of mummies exhibited at the Centennial, even the lapse of ages has not determined the disappearance of either skin or hair. Fabrics, wooden vessels, and food have been found in the tombs in perfect condition: and as it was the custom of the ancient people to inter with their dead their choicest ornaments and objects of utility, a rich treasure is now open to antiquarians, from which it is possible to determine the habits and manner of life of the Peruvians during the period prior to the Spanish conquest.

A collection of these relics now exists in Paris, at the Musée de St. Germain, and is to form a portion of a still larger gathering relative to ancient life in America, which is to be exhibited at the French Exposition of 1878. Several of the more interesting objects are represented in the annexed engravings, for which we are indebted to *La Nature*.

There was recently exposed for sale in this city a collection of Peruvian remains, which were sold at ridiculously low prices. The condition of the objects was scarcely such as to tempt the collector of bric-a-brac, however interesting they might have been to the antiquarian; but despite the prevalent dilapidation, we noted, on examining the articles, the remarkable state of preservation of the woven fabrics—a circumstance which our contemporary also considers the most phenomenal feature in the fine French collection; not only is the tissue intact—as our engravings indicate—but the colors have kept their primitive brilliancy, and this although the fabrics seem but rough specimens of woolen weaving. The designs are always either fantastic or combinations of geometrical figures. Grotesque representations of animals are frequently introduced, as witness the remarkable cubical birds and the geometrical cats shown in Fig. 1. The man represented is an astonishing figure: and it will be noticed that he is provided with but four toes or fingers on the respective limbs. This is an invariable peculiarity in the pictures of the ancient artists of the country, which has not yet been accounted for. On the right of the engraving are two birds, which look like geese or swans, and which, strange to say, closely resemble the birds of like species represented on ancient Etruscan vases. We can commend these designs to those who are searching for new grotesqueries for Eastlake rugs. Mr. Eastlake suggests figures of animals not accurately drawn but possessing character, and these certainly answer the requirements.

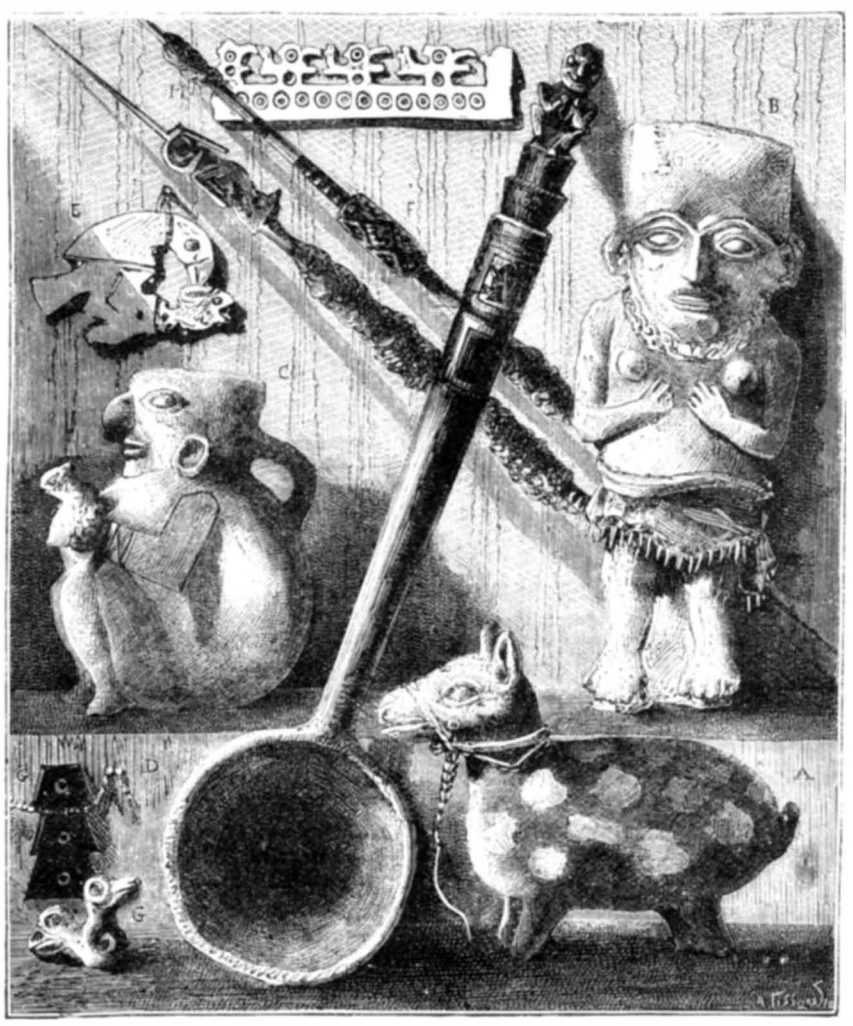
Besides manufactured fabrics, distaffs and spindles, used for spinning the cotton or llama wool yarn, of which they are woven, have been found. The spindles, F, Fig. 2, are often ornamented with pearls and are gaily painted. Hanks of yarn and hand looms, the latter roughly made of sticks, have been exhumed, and even pins and needles. The pins are simply long thorns, the thick portion at the point of junction with the branch serving as the head. The needles are the same, having a hole for the thread.

In Fig. 2 are represented a number of other curious articles. D is a wooden spoon with carved handle; A is a llama in pottery, and B a terra cotta statuette of a woman; G and E are pendants in mother-of-pearl and ebony. H is an ivory ornament; and C is a red earthen vase representing a man seated.

Not only are objects of metal and wood found in the tombs, but some beautiful specimens of glassware have been obtained. The glass is perfectly clear; and as there is no evidence that the people possessed the material for making it, it would follow that it was imported; but whence, it is impossible to tell. The glass vase represented in Fig. 1 is of light blue color, ornamented with opaque white glass, which bears the traces of gilding. The ornamentation bears no resemblance to that commonly employed by the Peruvians, and thus another proof is added of its foreign origin. The handle and the neck were made separately, and fastened on afterwards in a manner which shows superior skill on the part of the workman. The neck is ornamented with a kind of griffin's head, which has no resemblance to any animal indigenous in Peru. It is supposed to have been brought from Asia, as it is believed that the Japanese and Chinese knew of the New World and maintained commerce with the inhabitant long before the discovery by Europeans. But the decoration is not Oriental, but strictly Spanish; and hence the more probable assumption is that the object was brought into the country by the Spaniards in the 16th century, and hence that the Ancon sepulchres were in use at that period.

PERUVIAN ANTIQUITIES, MUSEE DE ST. GERMAIN, PARIS.—Fig. 1.

NEW GUANO DEPOSITS.—An English commission, sent to examine some recently discovered guano deposits to the south of Tarapaca, in Peru, has confirmed the reports of previous explorers as to the immense quantity of the deposit, amounting to at least 10,000,000 tons; and it is richer in ammonia and phosphates than that of the Chincha Islands.



PERUVIAN ANTIQUITIES, MUSEE DE ST. GERMAIN, PARIS.—Fig. 2.

Photographing Machinery.

It is a common practice with large manufacturers of machinery in this country and in England to have photographs taken of their products, especially of any new class of machine, to send to customers. For producing good photographs of this kind, the *British Journal of Photography* makes the following suggestions:

To execute this class of work successfully, every contingency must be provided against—not alone in the direction of chemicals, but in apparatus equally as well. A swing-back camera is indispensable. It frequently happens that the object to be photographed is in such close proximity to the camera itself—some portions of it lying in a plane oblique to that of the camera back—that accurate focussing can only be thus obtained, unless a stop of such diminished aperture be made use of that the exposure becomes so long as to introduce too many elements of non-success. Again: the usefulness of a swing-back will be seen when an object of regular form lies on the ground close to the camera, which latter has to be tilted to get the object in the field of view at all. Here a swing of the back—the top outwards—prevents all want of truth in the perpendiculars, and there will be no fear of the result representing a truly constructed machine with sloping sides and irregular contour.

For the successful prosecution of this class of work a good selection of lenses is necessary. The size of the picture required is generally fixed upon beforehand; and as the standpoint is often of limited area, if not absolutely fixed, there are not afforded the opportunities that landscapists enjoy in the selection of their point of view. The lenses, it must be remembered, should be chosen for their focus—not from their being wide or narrow-angled, quick, or slow. Let the latter qualities, of course, govern one in deciding; but the focus of the various lenses should so rise, step by step, that, wherever the point of view may be chosen or fixed upon, one lens may be found among the series which will take the picture the required size. The lens selected, the diaphragm used should be the largest it is possible to employ with the aid of a swing-back.

It will frequently happen that the object to be photographed lies at one end of a dark workshop. It would, then, be greatly conducive to rapidity and excellence of results if it could be brought forward, perhaps, into the open air; for it very commonly happens that the windows or skylights which illuminate such places are covered over with a fuliginous deposit, which seems to rob the light which passes through them of every particle of actinic power.

At this point it will be well to mention a very useful wrinkle. It will be impossible to get a very satisfactory picture of an iron casting, or, indeed, any metallic object which is not finely polished, unless it be purposely painted beforehand in a special manner—that is, with turpentine flatting—a light slate color being the tone most advisable, as its photographic value can be seen at a glance, without the chance of miscalculation which a green or a brown, for instance, might offer. This will be found to be a matter whose usefulness cannot be too highly valued. The contrast between a machine, no matter how excellently photographed, which has not been specially painted and the same subject with a coating of the flatting, will be so great that no one who has once seen the two would think of photographing an unpainted piece of ironwork if he could possibly avoid it. There is one precaution to be taken in laying the color on which, though it is more especially the painter's province to look after, may be pointed out here: it is that it should be made with so little oil or gold size that it will not dry patchy or cloudy—that is, with some parts dead and some bright. The effect then produced would be worse than if the machine had remained untouched.

During the exposure care must be taken that no workmen are allowed to lounge about and smoke; for it is remarkable what a small amount of smoke will suffice to fog a picture if it blow across the field of view, this being due, no doubt, to the highly actinic quality of the light reflected from the minute particles composing the smoke. We once had an otherwise excellent negative ruined through a similar cause, but from another source. The wind was strong, and carried a puff

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of smoke from a neighboring office chimney right into the open doorway of the room in which we were photographing; it permeated the whole atmosphere of the place, and rendered it impossible to secure a clear negative, though at the moment the occurrence was not noticed.

When the negative is obtained, it will generally be found that the background will be required to be eliminated, plain white paper being generally preferred by manufacturers to show off the peculiarities and excellences of their machines, there being no chance of confusing their details with those of the surrounding machinery in the background. To stop out all these and leave a white background, we have tried a multitude of expedients, but find no plan better than to make an edging of about half an inch by means of Bates' black varnish, carefully following the outlines of the machine as accurately as possible, and then placing a paper mask to block out the whole of the ground left outside this edging. This plan reduces the risk of cracking from the black varnish, and is at the same time more expeditious. We have tried Indian ink, gamboge, and water colors *ad libitum;* but we find it most difficult to obtain the requisite body to stop out all the light, so as to avoid any stain or streak.

We trust that the few points that we have touched upon may tend to render this class of work easier to those intending to try it, and we advise all, from a pecuniary standpoint, to do so when the occasion offers; for it is certain that in time to come photography will be more and more in request for work of this description, and we are in a position to state that, even in small establishments, the annual expenditure for photographs of machinery forms a conspicuous item.

Dangerous Paper Hangings.

The sanitary chemist of Breslau, Dr. Franz Hulwa, reports that he has frequently found not inconsiderable quantities of arsenic in tapestries and hangings sent to him for examination. It was not alone in the well known bright green paper that arsenic was found, but also in bluish green, gray, brown, and red patterns, corresponding to similar results in other places.

In most cases it was not due to the direct use of arsenical pigments like Scheele's green, Paris green, Braunschweig or Brunswick greens, orpiment, royal yellow, etc., but the arsenical reaction was so strong that it ought not to be passed over in silence. The presence of arsenic was attributable in some cases to impurities or adulterations; sometimes it was referred to additions made to brighten the shades of color. Not infrequently suspiciously bright green paper was printed over with harmless dull green to make it more salable. Such hangings must be the more dangerous because people are deceived in regard to their poisonous characters. In one such case, a dull bluish green pattern was found to contain a surprisingly large amount of arsenic. In another beautiful green and very elegant velvet paper, the arsenic was evidently added to increase the brilliancy of the colors. The amount of arsenic on 1,000 square feet of surface of this paper, enough for a large room, was about 2 grammes, or 30 grains.

Lakes, which are precipitates from alkaline solutions of organic coloring matter by means of alum or chloride of tin, frequently have arsenic added to them to make them brighter and more pleasing. These lakes were made of madder, cochineal, and sandal wood; but the brightest and most beautiful are the lakes made with aniline colors with the addition of arsenic. In the lakes we meet with a series of dangerous colors previously but little noticed; these colors must now all be suspected of containing arsenic. Reichardt of Jena found from 1·96 to 3·49 per cent of arsenious acid in such lakes which were designated as free from arsenic. Hallwachs, of Darmstadt, found an enormous quantity of arsenic in a very popular Pompeiian red paper hanging. In one French paper, printed with dark red velvet flowers on a gold ground, arsenic was distinctly proven by the Reinsch, Bettendorf, and Marsh tests, and with Fleck's silver solution.

Arsenic is least suspected in the dull gray or brown hangings. These indefinite mixed colors are frequently made from the residues of different dye pots and contain arsenic, partially for this reason, and partially because of the greater or less contamination of the raw materials used in dyeing with this poisonous substance. These phases of the case were observed both in a yellowish gray paper with gold figures, and one of light and dark pattern; the brown contained 2·1 grammes on a surface of 1,000 square feet. Although these figures are relatively small as compared with those of Sonnenschein, where green papers contained 1·8 to 4·4 grammes of arsenic in a square foot of surface, yet in general the injuriousness of arsenical hangings has been established. Gmelin first proved that living in rooms covered with arsenical paint or paper was very destructive to health; and these facts were substantiated by Oppenheim, Bunsen, Von Fabian, Kletzinski, Philips, and others. Beside the above-mentioned investigators, the following chemists have examined this subject, namely, Gintl, Wittstein, Halley, Williams, Basedow, Vohl, Kirchgäser, Hager, Hamberg, and others. Recently Fleck has furnished the most striking proofs, by his very interesting and rationally conducted experiments, that not only does breathing the arsenical dust loosened from the walls and hangings injure the health, but that, by the action of moisture and adhesive organic substances, like glue, paste, and gum, the arsenical pigments evolve that terribly poisonous arseniuretted hydrogen gas, which is diffused through the room and may be the cause of dangerous illness. It is desirable, says Hulwa, to direct public attention to the use of arsenical colors in clothing, artificial flowers, toys, window and lamp shades, wafers, and other articles. The public must be continually taught that arsenical colors have already done much harm and are capable of seriously injuring the health, and ought, as much as possible, to be excluded from common use. The sanitary police of Breslau, acting on Hulwa's suggestion, have passed an ordinance forbidding the sale of goods colored with arsenical dyes or pigments.

The New German Patent Law.

The new German Imperial Patent Law has just been passed by the Reichstag and will come into force on the 1st of July next. This new law puts an end to the disorder concerning patents in Germany that has existed until now, there being at the present time twenty-one different States granting patents of their own. These will be all embraced by one law after the 1st of July, and this a good and practical one, far better than many now in force in other countries. Pharmaceutical compounds, medicines, alimentary preparations, and chemical products cannot be patented under the new law; processes, however, by which these articles are obtained, can be patented. An invention must be novel, and not have been introduced to the public so that another person can imitate the same. Imported inventions are patentable only to the real inventor. Foreigners must be represented by a German citizen. It is unlawful to manufacture a patent article, to import the same from another country, or even to use without permission a patented machine, tool, apparatus, or process. Any one having an invention in use cannot be prevented from continuing to use the same. A patent remains good for fifteen years on payment of an annual tax. The duty may be paid three months after date. Patent rights may be withdrawn by the government after three years if the invention has not been carried into operation to a proper extent, or if the inventor has not taken the necessary steps to carry the patent into effect, if he refuses licenses to others who offer a fair royalty, or if it is advisable for the public good to grant such licenses. When the invention or improvement relates to purposes of war or marine, or affects the general welfare, a patent will not be granted, but the inventor will be recompensed by the State. The decision in this case will rest with the Imperial Chancellor. Any one having obtained a patent for improvements on a patented article, and wanting a license from the first inventor, is obliged to give the latter a license for his improvements. The applications will be examined by the Patent Commissioners and experts appointed for this purpose; an appeal can be made, in case of refusal, to a special commissioner, and from him to the Imperial Court at Leipsic. In the case of poor inventors, the payment of duty will be postponed for two years, or may be altogether remitted. Specifications and drawings can be inspected immediately after the application; on account of this, patents should be taken in other countries first. Patents being delivered, a short specification of the same will be published in the "Patent Journal." Infringements of patent rights are punished with a fine or imprisonment not exceeding one year. Marking articles as patented which are not so, is punished with a fine. At the publication of the invention, any one thinking he has a prior right, may enter an opposition, which is then examined in the presence of those concerned. Existing German patents may be transferred to the Empire, but cannot be prolonged.

Paris Cement White a Substitute for White Lead.

The best coating for painting has hitherto been white lead, the manufacture and use of which are so injurious to workmen that Mr. L. Henry, of Paris, has sought a product which, while rendering the same services as white lead, does not present the disadvantages mentioned, and he claims that he has not only attained that object but gone beyond it, as his product is superior to white lead, without taking into account that it is 50 per cent cheaper, and that with an equal weight he can cover one third more surface. All cements do not completely destroy humidity or damp, they only isolate it, and little by little the layer of paint is eaten away. The Paris cement white will be found of great service used as a cement, that is to say, applied upon the moist or damp parts as mastic, and the paint placed over it will always preserve its freshness, will not peel off, and there will be no blisters; this part will be as hard as stucco. When executing rich or costly works, it will only be necessary to use Mr. Henry's cement as mastic to obtain panels of a brilliant whiteness or marbled, as may be desired, and with a perfect polish. In order that the resistance of the composition may be understood, he gives a comparison. It is well known that when it is desired to remove paint from a signboard, for example, the painter is obliged by means of a small apparatus to apply flame to the part first coated in order to remove the white lead; now, his composition resists this firing, thus proving its hardness, and it also resists potassium. The Paris cement white is manufactured like white lead with kneading machines; it is, therefore, delivered in a paste, and when to be used for painting it is dissolved in linseed oil, as is done with white lead; it consists of whiting or Spanish white, baryta, oil, water, and zinc. He does not give the proportions of each product, as they vary with the quality of the said products and their destined use, whether at a mastic cement, for painting, for preserving railway sleepers, for making troughs or tanks watertight, and the innumerable other purposes to which his composition made of the above-mentioned matters in various proportions may be applied. The invention will be of considerable importance to mines producing barytes, as it will extend the market, whilst it will be of equal interest to consumers, since they can use the Paris cement white at a low price, instead of paying the price of white lead for a material a large proportion of which consists of baryta.

Two Great Crops.

The United States produced last year a cotton crop worth about $250,000,000, and a corn crop worth about $583,000,000. Of a total agricultural product of $4,000,000,000 the corn crop forms the largest item, being largely more than double the value of the crop which used to be called the King of American commerce. The King has now laid aside his purple robe and crown of jewels and become a highly respectable citizen, who is well received everywhere, but the whole of his estate is far less than that of his plebeian neighbor, Indian Corn, who enters into the business of society in a wonderful variety of forms. His guests sit down to a homely bill of fare, offering hominy, griddle cakes, egg bread, roasting ears, pudding, Johnny cake, popcorn. He shows with pride his well-filled stockyards of corn-fed beeves and porkers, which supply the home and foreign markets with the finest meat in the world, from the sweet beefsteak to the fragrant sugar-cured ham, fit for the table of a king. He has immense factories employed making starch and syrup, consuming millions of bushels. He runs great distilleries, which send out alcohol enough to float a fleet of war vessels, furnishing material to the arts, revenue to the government, rascality to the whiskey rings, and themes to the temperance lecturers.

The developments and applications of the great Western crop being so much greater than the Southern crop, it is not strange that the former is the stronger of the two. The principal use of cotton is for clothing; and while it has an excellence for that purpose, there are many substitutes for it, and its extinction would be a serious but not an irreparable loss to commerce.

The extinction of the corn crop would not only take from commerce a merchandise of more than twice the value of the other, but it would revolutionize many departments of trade.—*Louisville Commercial.*

A Possible Utilization for the Tramp.

Since writing our recent article on "Sewage Irrigation on a Small Scale," it has occurred to us that the chief item of expense in this most advantageous utilization of waste, namely, cost of labor of digging trenches, laying drain pipes, pumping, etc., might be materially compensated for by compelling tramps to do the work. It is a fact that the number of these vagrants is increasing, while society still stands puzzled before the problem of how to protect itself against them. Putting aside the actual depredations committed, their idleness alone renders them a dead weight upon the producing classes; and it therefore logically follows that no remedy which does not compel these vagrants to contribute their quota of useful effort toward the general welfare can ever reach the root of the evil. It is universally conceded that work is the punishment most dreaded by the tramp. Make it hard work, such as is involved in digging and pipe laying, and he will fear it the more. If, therefore, a village or town, desiring to test the profitableness of sewage irrigation, should, whenever a tramp comes within jurisdictional limits, arrest him under a vagrant act, and compel him to labor for so many days, it would probably be found that the necessary irrigation works could then be cheaply constructed, or the other much to be desired result, of suppressing the tramp nuisance in the vicinity, attained.

Zigzag Sparks.

With a view to finding the cause of the peculiar zigzag form taken commonly by electric sparks, especially those of the Holtz machine, in air, Professor Tait, of Edinburgh, has recently had a number of photographs of such sparks prepared. These sparks were produced partly in ordinary air, partly in the free air one or two feet above the flame of a strong Bunsen burner, partly in a wide glass tube, into which air was passed through a long iron tube, heated to a dark red glow. The general result of the examination is that the zigzag form depends on something which heat is capable of removing from the air. This is, therefore, not water vapor, nor is it very small drops of water, for even falling water drops were inactive, except that they produced simply an interruption in the photographed sparks. It is probably, the author thinks, organic substances which, as Schiller and Pasteur have shown, would be kept away from the apparatus by a cotton stopper as well as by direct combustion.

Fletcher Harper.

Mr. Fletcher Harper, the surviving member of the original firm of Harper & Brothers, one of the largest publishing houses in the country, recently died in this city at the age of 71 years. Mr. Harper began work as an apprentice to his elder brothers; and when 19 years old, having become proficient in his trade, he was admitted into partnership with them. It was through his enterprise that the several periodicals now published by the firm were started; and until his virtual retirement from active business, two years ago, they were the objects of his constant care. He was a man of great executive ability, and of superior business capacity; in brief, one of those upright, intelligent, industrious citizens, whom every one respected, whose death is a loss to the community, and whose life was an exemplification of the rewards which justly fall to honest labor and sterling worth.

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The Value of Small Inventions.

An excellent exemplification of the large returns which a small invention may often bring to its fortunate originator is found in the experience of Mr. Charles W. Cahoon, who recently died at Portland, Me. Mr. Cahoon possessed much inventive ability, besides that quality of persistent determination to succeed which usually characterizes the successful inventor. It is said that he realized sixty thousand dollars out of a little lamp burner, which had an appliance for lifting the chimney so that the wick could be reached for lighting or the mouth of the lamp for filling. This saved the frequent removal of the chimney while hot, and so doubtless prevented many fingers from being burned and many chimneys from being broken. Simple as was this device, Mr. Cahoon studied hard over it, and nearly lost his eyesight by persistent watching of the lamp flame under different conditions. It was the first invention of the kind patented (February, 1861), and infringers were plenty, but Mr. Cahoon protected his rights manfully and triumphed in the end. It is to be regretted that he could not have lived longer to have enjoyed the fruits of his strivings.

NEW BOOKS AND PUBLICATIONS.

BLUE AND RED LIGHT. By S. Pancoast, M.D., Philadelphia, Pa.: T. M. Stoddart & Co., 723 Chestnut street.

This appears to be an attempt to galvanize new life into the moribund blue glass mania, through the production of some alleged benefits to invalids, supposed, this time, to be derived from red glass. A sense of duty to our readers has impelled us to devote some utterly wasted time to the examination of this work, which we now consign to the waste basket with the conviction that it contains more profound bosh than it has ever been our misfortune to find in so few pages—Pleasonton's book not excepted.

DIGEST OF COTTON BALE TIES. By Messrs. L. W. Jinsabaugh and T. C. Tipton. Price $10. Published by the authors.

This is another one of those very valuable digests of special classes of inventions, several of which works have already been prepared by gentlemen connected, as are the present authors, with the United States Patent Office. We have no doubt but that this volume will prove exceedingly useful to inventors, manufacturers, and patent experts interested in its subject-matter. It is admirably compiled, and all the drawings are given complete, on a reduced scale. We should like to see more digests of this kind appear, one for instance on churns, another on cultivators, and another on beehives. The railroad people have been asking for just such a work on car couplers for a long time.

ANNUAL RECORD OF SCIENCE AND INDUSTRY FOR 1876. Edited by Spencer F. Baird. Price $2. New York city: Harper & Bros., Franklin square.

This volume purports to be a complete history of the progress of science and industry for the past year. It consists, first, of a series of summarized reviews by Professor Barker, Dr. Dana, Professor Holden, and others, and, second, of a compilation of receipts mostly from technical periodicals.

DECISIONS OF THE COURTS.

Supreme Court of the United States.

PATENT FLOUR PROCESS.—WILLIAM F. COCHRANE, WILLIAM WARDER, RODNEY MASON, W. S. COX, *et al.*, APPELLANTS, *vs.* JOSIAH W. DEENER, GEORGE W. CISSELL, JAMES H. WELCH, *et al.*

[Appeal from the Supreme Court of the District of Columbia.—Decided October term, 1876.]

The powers of the supreme court of the District of Columbia, in patent cases, are the same as those of the circuit courts of the United States.

Upon a bill in equity for the infringement of a patent it is a matter of discretion, and not of jurisdiction, whether a case shall be first tried at law; and in this matter, the courts of the United States, sitting as courts of equity in patent cases, are much less disposed than the English courts are to send parties to a jury before assuming to decide upon the merits.

The jurisdiction of the circuit courts in cases arising under the patent and copyright laws is not changed by the Revised Statutes, and consequently the original cognizance of the circuit courts sittings as courts of equity in patent cases is retained.

Where it is discretionary with a court of equity whether it will first send a case to be tried at law, and it exercises its discretion to decide the case upon its merits without the aid of a jury of any sort, such action is not a ground of appeal.

But if the appellate court were convinced that the case was not properly decided, and could not be properly decided without such a reference, it might, in the exercise of its own discretion, remand it to the court below for that purpose.

It does not detract from the validity of a patent that the inventions of others are made use of in carrying out the patented invention. One invention may include within it many others, and patents for each and all be valid at the same time, but in such case each inventor would be precluded from using the inventions made and patented prior to his own, except by license from the owners thereof.

A process is a mode of treatment of certain materials to produce a given result, an act, or a series of acts, performed upon the subject-matter to be transformed or reduced to a different state or thing, and if new and useful it is patentable.

The patentability of a process is entirely independent of the instrumentalities employed, and it is immaterial whether or not the machinery pointed out as suitable to perform the process be either new or patentable.

The process requires that certain things should be done with certain substances and in a certain order; but the tools to be used in doing this may be of secondary consequence.

In the language of the patent law a process is an art.

One device may be the equivalent of another in the general combination with other elements, and yet, when taken by themselves as separate pieces of machinery, they may not be the same, and the use of one not the infringement of a patent for the other.

While the parts of machinery which go to make up a combination could not when separately considered be regarded as identical or conflicting with those described in a patent, yet having the same purpose in the combination, and effecting that purpose in substantially the same manner, they are the equivalents of each other in that regard.

A foreign patent in order to invalidate an American patent must antedate the invention patented.

Mr. Justice Bradley delivered the opinion of the court:

This is a suit in equity, instituted in the supreme court of the District of Columbia for injunction and relief against an alleged infringement of various patents belonging to the complainants. The bill was dismissed, and the complainants have appealed.

The patents sued on are six in number, originally five granted to the appellant Cochrane on the 13th of January, 1863, and numbered respectively 37,317, 37,318, 37,319, 37,320, and 37,321. They all related to an improved method of bolting flour, the first being for the general process, and the others for improvements in the different parts of the machinery rendered necessary in carrying on the process. Three of the original patents, Nos. 37,317, 37,318, and 37,321, were surrendered, and reissues taken in 1874, which reissues were numbered 5,841, 6,029, and 6,030, the first being for the process, and the other two for portions of the machinery. Reissue 6,029, being in place of the original patent numbered 37,321, was also subsequently surrendered, and two new reissued patents substituted therefor, numbered 6,594 and 6,595.

The case has been mainly argued on the question of infringement, the defendants using a bolting apparatus constructed according to letters patent issued to Edward P. Welch, in April, 1873, for improvements upon machines patented to Jesse B. Wheeler and Ransom S. Reynolds, which, as well as the process employed, they contend, are radically different from the apparatus and process of Cochrane.

A preliminary question is raised with regard to the jurisdiction of the court below to hear the case on a bill in equity, before a determination of the rights of the parties in an action at law.

The powers of the supreme court of the District of Columbia, in patent cases, are the same as those of the circuit courts of the United States. (See Revised Statutes relating to the District of Columbia, sections 760, 764.)

* * * * * * *

The principal patent sued on in this case was granted on the 21st of April, 1874, being a reissue of a patent granted to William F. Cochrane on the 6th of January, 1863. The original patent was numbered 37,317, and the reissue 5,841. The alleged invention is for a process in manufacturing flour. The patentee in his specification says:

"The object of my invention was to increase the production of the best quality of flour; and my improvement consisted in separating from the meal first the superfine flour, and then the pulvurulent impurities mingled with the flour-producing portions of the middlings meal, so as to make 'white' or 'purified' middlings, which, when reground and rebolted, would yield pure white flour, which, when added to the superfine, would improve the quality of the flour resulting from their union, instead of deteriorating its quality, as had heretofore been the case when the middlings were mingled with the superfine."

The process employed for producing the result here indicated is then described. It consists in passing the ground meal through a series of bolting reels clothed with cloth of progressively finer meshes, which pass the superfine flour and retard the escape of the finer and lighter impurities; and, at the same time, subjecting the meal to blasts or currents of air introduced by hollow perforated shafts furnished with pipes so disposed that the force of the blast may act close to the surface of the bolting cloth; the bolting chest having an opening at the top for the escape of the air, and of the finer and lighter particles therewith, through a chamber where the particles are arrested, while the floor and sides of each compartment of the chest are made close so as to prevent the escape of the air in any other direction than through the said opening. By this means the superfine flour is separated, and the fine and light specks and impurities, which ordinarily adhere to the middlings and degrade the flour produced therefrom, are got rid of, and when the middlings are now separated from the other portions of the meal, they are white and clean, and capable of being reground and rebolted, so as to produce superfine flour equal in quality, and even superior to the first installment.

This is the process described; but the patentee claims that it is not limited to any special arrangement of machinery. He admits the prior use of currents of air in the interior of the reels, introduced by means of hollow perforated shafts, for the purpose of keeping back the speck and increasing the quantity of superfine flour; but not for purifying the middlings preparatory to regrinding. His improvement, therefore, does not consist in using drafts and currents of air, but in the process as a whole, comprising the application of the blast, and the carrying off of the fine impurities, whereby the middlings are purified preparatory to regrinding after being separated from the other parts.

The defendants deny that they use this process. They purify the middlings of the flour, as before stated, by means of machines constructed according to letters patent issued to Edward P. Welch, in April, 1873, for improvements upon machines patented to Jesse B. Wheeler and Ransom S. Reynolds.

In this process reels are not used for purifying the middlings, but a flat and slightly inclined vibrating screen or sieve is used for the purpose, over which the ground meal is passed, and while passing is subjected to currents of air blown through a series of pipes situated close underneath the screen, which currents pass up through the screen and through an opening at the top of the chest into a chamber, carrying with them the finer and lighter impurities, whereby the middlings are rendered clean and white, and capable of being reground into superfine flour. The bolting chest is made tight and close on all sides except the opening at the top, so that the currents of air may be forced to escape by that exit.

Now, except in the use of a flat sieve or screen in place of reels, it is difficult to see any substantial difference between these two methods. The defendants use, in addition, brushes which revolve on the under side of the screen, so as to keep the meshes thereof constantly clean and free; but this is merely an addition, which does not affect the identity of the two processes in other particulars. We have substantially the same method of cleaning the middlings preparatory to regrinding by means of currents of air passed through them while being bolted, and while being confined in a close chest or chamber, said chamber having an opening above for the escape of said currents of air and the impurities with which they become loaded. The middlings being thus purified are reground and rebolted, producing a superfine flour of superior grade, a new, useful, and highly valuable result.

The use of a flat screen instead of a revolving reel for bolting and cleaning the middlings is a mere matter of form. It may be an improved form, and, perhaps, patentable as an improvement. But it is at most an improvement.

The forcing of the air currents upward through the screen and film of meal carried on it and against the downward fall of the meal, instead of forcing them through the bolting cloth in the same direction with the meal, is also a mere matter of form, and does not belong to the substance of the process. The substantial operation of the currents of air in both cases is to take up the light impurities and bear them away on the aggregate current through the open flue and thus to separate them from the middlings. This, too, may be an improvement on Cochrane's method, but it is only an improvement.

The defendants admit that the process has produced a revolution in the manufacture of flour; but they attribute that revolution to their improvements. It may be, as they say, that it is greatly due to these. But it cannot be seriously denied that Cochrane's invention lies at the bottom of these improvements, is involved in them, and was itself capable of beneficial use, and was put to such use. It had all the elements and circumstances necessary for sustaining the patent, and cannot be appropriated by the defendants, even though supplemented by, and enveloped in, very important and material improvements of their own.

We do not perceive that the patent of Cogswell and McKiernan, if valid at all as against Cochrane (a point which will be more fully considered hereafter), affects the question in the least. That patent is not at all for the patent which Cochrane claims. If valid, and if, in using his process, Cochrane is obliged to use any device secured to Cogswell and McKiernan, it does not detract in the slightest degree from his own patent. One invention may include within it many others, and each and all may be valid at the same time. This only consequence follows, that each inventor is precluded from using inventions made and patented prior to his own except by license from the owners thereof. His invention and his patent are equally entitled to protection from infringement as if they were independent of any connection with them.

That a process may be patentable irrespective of the particular form of the instrumentalities used, cannot be disputed. If one of the steps of a process be that a certain substance is to be reduced to a powder, it may not be at all material what instrument or machinery is used to effect that object, whether a hammer, a pestle and mortar, or a mill. Either may be pointed out, but if the patent is not confined to that particular tool or machine, the use of the others would be an infringement, the general process being the same. A process is a mode of treatment of certain materials to produce a given result. It is an act, or a series of acts, performed upon the subject matter to be transformed and reduced to a different state or thing. If new and useful it is just as patentable as is a piece of machinery. In the language of the patent law, it is an art. The machinery pointed out as suitable to perform the process may or may not be new or patentable, while the process itself may be altogether new, and produce an entirely new result. The process requires that certain things should be done with certain substances and in a certain order; but the tools to be used in doing this may be of secondary consequence.

The machine patents come next to be considered.

As to No. 6,030, which is a reissue of the original patent No. 37,318, the defendants clearly infringe, at least the last claim, which is in these words:

"In combination with the screen incased in a chest, the perforated blast pipe and the suction pipe, arranged to operate on opposite sides of the screen, substantially as set forth."

As to the patent next in order, namely, the original patent No. 37,319, which relates specially to the use of what the patentee calls the pump for introducing the meal into the chest and reels, while the valve arrangement used by the defendants may be an equivalent in the general combination with the said pump described by Cochrane, yet, taken by themselves, as separate pieces of machinery, they are not the same, and the use of the one is not an infringement of a patent for the other. (Curtis, sec. 332; Foster *vs.* Moore, 1 Curtis, C.C.R., 279). Nor can we perceive that the defendants infringe the next patent, No. 37,320, which is for certain combinations of machinery, including the bolting reels, dead air chambers therein, slotted shaft, and reciprocating board for discharging the meal, etc., which it is unnecessary to describe more particularly.

The two remaining patents, No. 6,594 and 6,595, being reissues of original patent No. 37,321, are for combinations of essential parts of the machinery required for bolting flour and purifying the middlings according to the general process described in the first patent. The principal claim of the original patent was for the condensing or collecting chamber, through which the currents of air on leaving the bolting chest make their escape, and where they leave the fine particles with which they become loaded. This claim, it is said, was found to be too broad, inasmuch as a collecting chamber somewhat similar had been used in another connection, though not in the combinations presented in Cochrane's bolting process. The original patent, therefore, was surrendered, and the two patents now under consideration were issued in place thereof, claiming the use of the collecting chamber in combination with the various material parts of the bolting apparatus. The reissue, No. 6,594, contains three claims, and No. 6,595 one claim.

The first claim of reissue No. 6,594 is for the collecting chamber (used for the purpose aforesaid) in combination with the bolter, air pipes, and valves for feeding and delivering the meal without allowing the air to pass therewith. Now, although the defendants use a flat bolter instead of a reel, and use different kinds of valves for feeding and delivering the meal without allowing the air to pass, yet they employ the combination of devices described in this claim. They use the collecting chamber for the same purpose as that pointed out in the patent, and use it in connection with a bolter, air pipes, and valves for feeding and delivering the meal without allowing the air to pass therewith, each effecting the same separate purpose, and all combined effecting the same general purpose, which the like parts are intended to accomplish in Cochrane's bolting apparatus. Though some of the corresponding parts of the machinery, designated in this combination, are not the same in point of form in the two bolting apparatuses, and, separately considered, could not be regarded as identical or conflicting, yet having the same purpose in the combination, and effecting that purpose in substantially the same manner, they are the equivalents of each other in that regard. The claim of the patent is not confined to any particular form of apparatus, but (in regard to the valves for example) embraces generally any valves for feeding and delivering the meal without allowing the air to pass through. We are of opinion, therefore, that the combination here claimed is infringed by the apparatus used by the defendants.

It is unnecessary to make a separate examination of the other claims embraced in the two patents under consideration. They are all susceptible of the same observations which we have made with regard to the first claim. In our opinion the defendants do infringe them.

But a question is raised with regard to Cochrane's priority of invention. A patent was granted on the 12th of June, 1860, to Mortimer C. Cogswell and John McKiernan for improvements in ventilating bolting chests, which, it is contended, antedates and nullifies Cochrane's apparatus as patented to him in the original patent 37,321, and in the two reissues thereof before mentioned. This patent (of Cogswell and McKiernan) we have examined and find that it does contain five of the elements embraced in those reissues, namely (besides the bolting chest and bolter which are always used), it contains the perforated air pipe extending inside of the bolting reel, the fan for producing a blast of air therein, and a collecting chamber for arresting the flour carried off by the blast. The purpose was simply to cool the meal and keep the bolting cloths dry. The flour which collected in the chamber was returned to the chest. The parts contained in this apparatus are those which are patented in combination in Cochrane's reissue 6,595, which was separated, it is said, from reissue 6,594 on account of this patent of Cogswell and McKiernan. The combinations patented in reissue 6,594 embrace other parts not contained in Cogswell and McKiernan's patent, and the defendants contend that this reissue is void as not being sustained by the original patent 37,321.

The latter position we think is untenable. Cochrane's apparatus, as exhibited in his model, and described in his original patent, and in the series of patents taken out at the same time, all having relation to the same general process, and referred to in patent 37,321, contained all the parts which go to make the combination claimed in reissue No. 6,594. We see no reason, therefore, why such reissue was not properly granted to him by the Patent Office—the claim being, in fact, a much narrower one than that of the original patent.

The same observations apply to reissue No. 6,595. But, as to that, as before stated, the particular elements of the combination claimed in it are found in Cogswell and McKiernan's machine; and if this is entitled to the precedency over Cochrane's, reissue No. 6,595 is void. He contends that it is not entitled to such precedency: but that, in fact, Cogswell and McKiernan surreptitiously obtained a patent for his invention. We have examined the evidence relating to this matter and are satisfied that the improvement claimed by Cochrane was his invention: that Cogswell and McKiernan obtained their knowledge of it from him; and that there is nothing connected with their patent which ought to invalidate the reissued patent in question.

A French patent dated 27th of September, 1860, granted to one Perigault, is also referred to as anticipating the combinations in these patents. But it being shown that Cochrane's invention was actually made before that date, the point was not pressed in the argument. By the act of 1870 a foreign patent, in order to invalidate an American patent, must antedate the invention patented.

Our conclusion is that the patent for the process being reissue No 5,841, and the several reissued patents for combinations of mechanical devices, numbered respectively 6,030, 6,594, and 6,595, are valid patents, and are infringed by the defendants; and that the other two patents named in the bill of complaint, numbered respectively 37,319 and 37,320, are not infringed by the defendants.

The decree of the court below is, therefore, reversed, and the cause is remanded with directions to enter a decree for the complainants and to proceed therein in conformity with this opinion.

Mr. Justice Clifford, dissenting.

I dissent from the opinion and judgment of the court in this case, for the following reasons:

1. Because the mechanical means employed by the respondents to effect the result are substantially different from those described in the complainant's patent.

2. Because the process employed by the respondents to manufacture the described product is materially and substantially different from the patented process employed by the complainants.

3. Because the respondents do not infringe the combination of mechanism patented and employed by the complainants. (Prouty *vs.* Ruggles, 13 Pet., 341; Vance *vs.* Campbell, 1 Black, 428; Gill *vs.* Wells, 22 Wall., 26.)

4. Because the respondents do not infringe the process patented by the complainants, the rule being that a process, like a combination, is an entirety, and that the charge of infringement in such a case is not made out unless it is alleged and proved that the entire process is employed by the respondents. (Howe *vs.* Abbott, 2 Story C. C., 194; Gould *vs.* Rees, 15 Wall, 193].

I concur in this dissent.—Strong, J.

[*R. Mason and Chas. F. Blake*, for complainants.
A. L. Merriman and Howard C. Cady, for respondents].

United States Circuit Court—District of Maryland.

INJUNCTION AGAINST THREATENING PATENTEES.—JOHN C. BIRDSELL VS. THE HAGERSTOWN AGRICULTURAL IMPLEMENT COMPANY.

[In equity.—Before Bond, C. J., and Giles, J.—Decided March, 1877.]

Motion to enjoin complainants from bringing suits against the defendants' vendees.

In this case, an injunction had been issued restraining defendants from infringing on the reissued patent granted complainant May 18, 1858; reissued April 8, 1862; for an improvement in machinery for hulling and thrashing clover. The defendants afterwards changed the construction of their machine and proceeded to sell clover hullers of the changed construction. On a motion made by complainant to commit them for contempt of court, for violating the injunction issued against them, by selling machines of this changed construction, the court held that, on the showing made, the machines were substantially different from Birdsell's patented machine; and, therefore, dismissed the motion. (See *Official Gazette*, March 13, 1877.) Thereafter complainant notified several of the vendees of defendants—some of whom were using the original machine that had been enjoined, and some of whom were using the machine as it had been changed—that, unless settlement were made with him forthwith, suit would be brought against them. Defendants, thereupon, moved upon a cross petition filed in the original case, for an injunction to issue against the complainant, restraining him, while the original suit was still pending against them, under which damages and profits could be collected for all the machines that they made and sold, from bringing any suit, or threatening to bring any suit against any vendees of theirs, based upon a user of a machine that might become subject of account in the original case.

Counsel for defendants, seeking the injunction against complainant, based their motion upon the general equity jurisdiction of the court; that, inasmuch as complainant had submitted himself to the jurisdiction of the court to obtain relief against the defendants, he was also subject to the order of the court in relation to any matter relating to the granting of that relief; that the defendants were thoroughly responsible; and that upon the original suit being carrid on to completion, if recovery was made, the complainant would recover in that suit all the profits that defendants had obtained from the wrongful manufacture, and the damages that he had suffered by reason of the wrongful manufacture, and that complainant would, therefore, be put in the same position as if he had originally sold all the machines. That, this being the case, he ought not to be allowed to interfere with the vendees of defendants while the suit against them was pending. In support of their position they cited the decrees of Judge Drummond in the case of Isaac W. Barnum *vs.* Herman B. Goodrich, entered in United States Circuit Court for the northern district of Illinois, July 2, 1873, wherein the complainant having brought suit against the defendant and obtained an order for defendant to keep an account of the sale of the devices alleged to be an infringement, was enjoined from prosecuting suits, already begun by him in other circuits, against the defendants' vendees, and from bringing any further suits against defendants' vendees; also the decree entered by the Hon. H. H. Emmons, United States Circuit Judge, and Hon. P. B. Swing, United States District Judge, in the circuit court of the United States for the southern district of Ohio, in the case of Hezekiah B. Smith *vs.* J. A. Fay & Co., restraining the complainant from bringing suit against the defendants' vendees in other circuits, the complainant in this case having obtained an interlocutory decree and a reference to the master, and the suit being, at that time, pending before master on the question of the account.

The defendants relied upon the fact that the complainant was a resident of Indiana, and not before the court, and had sought the jurisdiction of the court for the purpose of bringing the suit, and for no other purpose. He was not, therefore, subject to any order upon him; that the court could not enforce an order if it made one, and it would not do an idle thing.

The respondents asking the order were represented by Hatch & Parkinson, of Cincinnati; the complainant by M. D. Leggett & Co., of Cleveland.

The court did not deliver a written opinion; but, having considered the matter, entered the following order:

DECREE.

Bond, J.:

This cause coming on to be heard upon the petition of the defendant herein for an injunction to issue against the complainant to restrain him from commencing or prosecuting, or threatening to prosecute, any suits against any of the vendees, or vendees of vendees of defendant, for the use or sale of clover hullers manufactured by the defendant at Hagerstown, and sold by them or their agents, and it appearing to the court that the complainant has been threatening to bring suits against said vendees while suit is still pending by him in this court against the defendant, the manufacturer, and the case having been fully argued by the counsel for the respective parties, the court doth order: That said John C. Birdsell, the complainant herein, be restrained and barred from commencing or prosecuting,

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or threatening to commence or prosecute, any suit against any vendee of this defendant, or any vendees of a vendee of this defendant herein, for any alleged infringement of the reissued letters patent involved in this case, and on which this case is brought, based upon a use or sale by said vendee of any clover machine purchased of this defendant;

Provided said defendant shall within thirty days file a bond in this case in the sum of five thousand dollars, with securities to be approved by the court, for the payment of any damages that may be adjudged against the defendant in the above entitled suit, and that defendant shall file in this court a sworn monthly statement of the number of clover machines hereinafter made and sold by them.

Inventions Patented in England by Americans.

From May 8 to May 14, 1877, inclusive.

BUTTON HOLE SEWER.—W. Randel *et al.*, Troy, N. Y.
CAR FARE REGISTER.—H. E. Towle, New York city.
CLEANING GUNS, ETC.—B. L. Budd, New York city.
GLOVE STRETCHER.—J. Herts, New York city.
LAMP BURNER.—Benedict & Burnham Co., Waterbury, Conn.
MOTIVE POWER FOR VESSELS.—T. S. Seabury, New York city.
PAINT OIL.—G. Walker *et al.*, Chicago, Ill.
ROLLING LEATHER, ETC.—A. F. Stowe, Massachusetts.
SCREW, ETC.—H. A. Harvey, Orange, N. J.
SHOE-FASTENING.—F. G. Farnham, Hawley, Pa.
SPEED GOVERNOR, ETC.—G. Westinghouse, Jr. (of Pittsburgh, Pa.). Liverpool, England.
WINDING REEL.—W. Grover *et al.*, Holyoke, Mass.
WOOD PAVEMENT.—F. C. Taylor, Chicago, Ill.

Recent American and Foreign Patents.

Notice to Patentees.

Inventors who are desirous of disposing of their patents would find it greatly to their advantage to have them illustrated in the SCIENTIFIC AMERICAN. We are prepared to get up first-class WOOD ENGRAVINGS of inventions of merit, and publish them in the SCIENTIFIC AMERICAN on very reasonable terms.

We shall be pleased to make estimates as to cost of engravings on receipt of photographs, sketches, or copies of patents. After publication, the cuts become the property of the person ordering them, and will be found of value for circulars and for publication in other papers.

NEW MECHANICAL AND ENGINEERING INVENTIONS.

IMPROVED BLACKSMITHS' TONGS.

James H. Gregory, Columbia, Tenn.—These tongs are so constructed that they may be used for holding two pieces of iron together, either straight or at any desired angle, for welding. They may be used as a clamp, for holding the two ends of a tire with any desired lap, for holding a piece or splice to be inserted in a tire, or for holding various kinds of blades and cutters to be ground, and for other similar purposes.

IMPROVED MILL SPINDLE BUSH.

Harvey T. Ashworth, Chatham, Va.—This consists of a bush for the eye of the bedstone, which is made of a block of hard wood or metal, and recessed for the reception of the cushioned journal blocks or followers. The latter are recessed near the upper end, and filled with a suitable lubricating mixture. The top of the journal block is tightly closed by a rubber cap fitting tightly around the spindle.

IMPROVED RAILROAD SIGNAL.

Charles Haise and Frank Haise, Atlanta, Ill.—This is an improved device to enable an approaching train to be signaled from the office, so that there may be no delay in making the signals when promptness is necessary. Wires and levers are so arranged that a lantern can be turned through a quarter of a revolution, so as to show a white or a colored light, as may be necessary.

IMPROVED CAR COUPLING.

Gurdin D. Lease, Jeffersonville, Vt.—This coupling couples in automatic manner by the entrance of the link. It consists of a longitudinally slotted drawhead with centrally pivoted and weighted lever bar, and curved or hook-shaped coupling pin, that is pivoted to the rear end of the lever bar, and dropped with the same by the action of the coupling link into a top recess and bottom pinhole of the drawhead, coupling thereby the link.

IMPROVED APPARATUS FOR CARRYING RAILROAD RAILS.

Andrew J. Gustin, St. Albans, Vt.—This is an improved apparatus by which the rails are taken up and conducted to the cooling bed, after having been passed through the bending rolls that impart the proper camber, so as to compensate for the unequal shrinkage of the rail while becoming cold. The device may also be used for moving the rails *en masse* from the position where they are left to cool to the end where they are taken off to the straightening machine. The invention consists of a bed frame with lateral chains and rail carrying shoes, the chains and shoes being guided in grooved rails, flush with the bearing rails of the bed, and the chains automatically adjusted to expansion and contraction by movable and weighted pulley bearings; also, two long screws with suitable bearings at the ends, and dogs shaped to fit the screws, and guided in grooves to hold them in position. The dogs are provided with trip latches, and the screws are connected with reversible driving shaft with gears.

IMPROVED PLATE PRINTING PRESS.

Horatio W. Browne, Philadelphia, Pa.—This consists in a novel device for moving the bed under the impression roll, the object being to increase the rapidity with which the impressions may be taken from the plates.

IMPROVED ROCK-DRILLING MACHINE.

Aaron J. Mershon, Warsaw, Ind.—This invention consists in the combination of a disk secured to a shaft, and having an arc-shaped slot, in the end of which is journaled a concave roller, with an arm placed loosely on the drill rod, and extending through the slot of the disk, so as to be engaged by the concave roller as the disk is revolved. It was fully described and illustrated on page 358, current volume.

IMPROVED REVOLVING ORE ROASTERS.

John Howell, Benton, Cal.—This is an improved rotary tubular furnace for chloridizing silver ores and desulphurizing copper, gold, lead, tin, and zinc ores. There is a revolving tube with a furnace at the receiving end, having the chambers, and a furnace at the lower end having a pit, into which the ore is discharged after treatment.

IMPROVED IRON MOULDING.

Joseph Hursh, New York city.—To the pattern is secured a male screw, projecting sufficiently to allow a key to be firmly screwed upon it. The screw is covered with a small slightly tapering cap, while the sand is being packed upon it, and which protects the threads of the screw from being filled with sand. When the cope is raised from the pattern the cap is either left upon the screw or taken off with the sand, and can then be drawn, in either case leaving a smooth hole in the sand, which can be easily filled. By this construction no time need be lost in freeing the screw threads from sand, and the same will not be worn by the latter.

IMPROVED SQUARE.

Charles A. Schrier, Holyoke, Mass.—The object is to so improve the universal square in general use that a line may be drawn along the whole length of the tongue or blade without removing the square from the roll or other object. To this end the square has a crossbar with curved or raised portion above the central edge of the tongue to admit the continuation of the line along the same.

IMPROVED GRAIN CRUSHER.

Joseph Reid and Robert Reid, Philadelphia, Pa.—This is a machine for crushing and pulverizing grain. Grain to be crushed is delivered to a hopper, and the machine being in motion, it is caused by vibratory motion to flow rapidly down a chute to the rolls by which it is crushed and delivered to another chute, through which it passes to a suitable receptacle.

IMPROVED PIPE TONGS.

Christian States and Harry I. Cook, Topeka, Kan.—This combines the advantages of a pipe tong, wrench, and screwdriver. It consists of a double jaw, with curved end and notches, in connection with a single jaw and lever sliding in the double jaw, and having projecting pivot pins for entering into the notches. This invention was illustrated and described on page 310, current volume.

NEW HOUSEHOLD INVENTIONS.

IMPROVED PICTURE FRAME.

Samuel Sargeant, Brooklyn, N. Y.—This consists in a frame formed of metal tubes, halved to each other, and secured to a back frame or board by screws passing through said back frame or board, through the inner sides of the said tubes, and screwing into pieces of wood placed within said tubes.

IMPROVED BOOTJACK.

John Niver, Sherman, N. Y.—This is an improved bootjack designed to be attached to a wall, and to be turned up against the wall when not in use.

IMPROVED LAMP BURNER.

Jonas Rasch, Christiania, Norway.—This is an improved round burner for petroleum lamps, on which the chimney may be adjusted to different heights, for the purpose of obtaining a more perfect combustion and better light. The chimney is quickly set at the proper elevation above the aperture of the burner by a simple mechanism.

IMPROVED SHIRT-DRYING APPARATUS.

John McCartan, New York city.—This is an improved apparatus for drying starched shirts, formed of a hollow metal plate, made of such a shape and size as to be passed into a shirt, which is spread out smoothly upon it. Hollow metal cylinders are made of a proper size for the cuffs of the shirt to be spread out upon them. The hollow plate and cylinders are each provided with a steam inlet pipe, through which steam is introduced from a boiler or other steam generator, and a steam outlet pipe, to enable the said plate to be brought to and kept at a suitable temperature to dry the shirt and cuffs quickly.

NEW MISCELLANEOUS INVENTIONS.

IMPROVED COMBINED LETTER SHEET AND ENVELOPE.

Leo Ehrlich, St. Louis, Mo.—This invention consists of a sheet of suitable size having sealing flaps that extend at one corner along a portion of the sides, so as to close in the nature of an envelope when the sheet is folded up.

IMPROVED PROCESS OF FINISHING CARDBOARD FOR PERFORATING.

Bernard Dreyfuss and Samuel Sachs, New York city.—This consists in coating a suitable quality of cardboard with a mixture of powdered metallic zinc, glue, starch, and wax. The board is given a bright silvery surface, which is very hard, and well prepared for perforation in the usual way.

IMPROVED PHOTOGRAPHIC PRINTING APPARATUS.

Oliver Sarony, Scarborough, England.—The object of this invention is to obtain by two successive exposures the title, tint, or fancy border on the same negative with the picture, so as to dispense with the use of registertering presses and registering tinting presses hitherto employed, and therefore with the second printing. A print having the appearance of what is known as a chromotype may be thus produced in the ordinary printing frame at one printing instead of two, as at present.

IMPROVED SLEEVE BUTTON AND STUD.

Alexander Goll, Frankfort-on-the-Main, Prussia, Germany.—This sleeve button or stud has an elastic piece of metal, double or open slotted, and attached to a flat pivot at the end of its bent shank.

IMPROVED APPARATUS FOR WEIGHING LIQUIDS.

John G. Valentine, Florence, Mass., assignor to himself and Edward Valentine, of same place.—This is a receptacle for liquids, that is suspended from a scale lever pivoted in a frame, in the handle of which is pivoted a spring connected by a scale with the said lever, for indicating the weight of liquids contained by the receptacle.

IMPROVED COFFEE ROASTER.

John A. Caldwell and Adolph F. Pleitz, Brownsville, Tenn.—This improved coffee roaster is so constructed as to keep the coffee constantly turning over, so that it cannot slide upon the vessel and burn.

IMPROVED SUSPENDER.

Leonard V. Richmond, Sand Lake, N. Y.—The suspenders are so made that whatever position the body of the wearer may take, the tautness of some of the straps will take up the slack of the others, so that there will be no perceptible strain upon any of the buttons.

IMPROVED GALLEY SUPPORT.

Peter A. Kelly, Baltimore, Md.—This is a support for printers' galleys, which may be readily attached to the case, and which may be folded out of the way when not in use. The device is put into position for use by placing hooks on the edge of the case, and unfolding the brackets so that they are at right angles to the frame.

IMPROVED BOX AND BOX HOLDER.

Joseph A. Cotten, Thomaston, Ga.—The object is to provide a means for handling boxes upon high shelves without the use of steps or necessity of climbing. The box has its end slotted and bent inwardly and supported by the strengthening band, the whole being adapted to engage with the grapple or lifter, which has a widened head for the purpose.

IMPROVED STRAP FASTENER.

Wesley Hyre, Collins, Ind.—This invention consists in a flat wedge-shaped case, and a wedge provided with the points combined with each other to adapt them for use for fastening a strap. In using the fastener, the strap is passed through the case. The wedge is then placed upon the strap, and the strap and wedge are drawn forward together into the case.

IMPROVED WATER CLOSET PROTECTOR.

Benjamin R. Brown, Petersburg, Va.—This consists in a sheet of paper provided with two circles or lines of punctures, forming between them a ring having an inwardly projecting narrow flap and an outwardly projecting wide flap.

IMPROVED SPRING FISH HOOK.

John O. King, Altamont, Kan.—This invention relates to that class of fish hooks which are sprung when the fish tampers with the bait, so as to close and catch the same. It consists of fulcrumed grab hooks having outer claws and U-shaped ends back of the fulcrum, in connection with a sliding loop at the end of a coiled hook actuating spring, the hooks being opened by a swinging trip lever, connected by a link to the spring loop, and set to a fulcrumed latch of the sliding and guided bait hook.

IMPROVED INDICATOR.

George W. Daniels, Lexington, O.—This is an index for account books, by which the name may be more readily referred to than in the indices usually applied to such books. It consists in a polygonal drum that turns on a vertical axis, and is inclosed in a suitable casing, and arranged to receive upon each of its sides a division of the alphabet, consisting of one or more letters.

IMPROVED CIGAR.

James H. Campfield, M.D., Ottawa, Ill.—The object of this invention is to render the smoke of cigars made of tobacco less offensive and injurious. In the process of manufacture, a chamber or cavity is formed in each cigar and a piece of sponge or other suitable absorbent material, which has been saturated with a solution of tannic acid, is inserted therein for the purpose of extracting from the smoke drawn through the cigar the nicotine and empyrematic oil, which are poisonous and inimical to health.

IMPROVED TOY SKATING RINK.

Sophie E. Bachmann, Tenafly, N. J.—The skating rink consists of a box having its top formed of paper or other thin material, representing ice, on which diminutive figures representing skaters, and weighted by means of iron shoes, are moved about by the attraction of a magnet held in the hand, and applied beneath the paper.

IMPROVED GRAIN-REDUCING APPARATUS.

Cyrus Bailey, Akron, O.—This consists of a perforated revolving cylinder or reel, that feeds the oats or other grain to fixed cutting knives, regulating the length of the projecting kernel portions by adjustable guard-plates. The holes through which the oats or other grain are dropped are straight at the end toward the knife, and inclined or countersunk at the other end to carry the grain into position for cutting.

NEW WOODWORKING AND HOUSE AND CARRIAGE BUILDING INVENTIONS.

IMPROVED SASH FASTENER.

Joseph Hatzl, Spades, Ind.—This consists of a sash with sliding and spring-acted bolts entering between guide strips of the window casing and into sockets of the same, the sash bolts being secured into the different positions required for locking, guiding, or removing the sash, by being set into corresponding recesses of the face plates of the bolt sockets.

IMPROVED SASH FASTENER.

William Kemp, Jr., New York city.—This consists in the combination of a sliding bolt, placed in a suitable guide that is attached to the upper meeting rail of the lower sash, and provided with a spindle and slotted arm for moving the bolt; and two slotted bars, one of which is attached to a stile of the upper sash, and the other to the roller stile or jamb of the window. The object is to simultaneously lock both sashes by a single operation and by a single bolt.

IMPROVED SAW SET.

William H. Smerdon, and Baylies F. Phillips, Taunton, Mass.—This consists of an anvil with pivoted and spring-acted set piece, and a gauge and bevel plate, jointly adjustable, so that there may be simultaneous adjustment of gauge and bevel to the saw teeth.

IMPROVED HORSE DETACHER.

Moses Amidon and Edgar N. McKimm, Lathrop, Mo.—The object of this invention is to furnish whiffletrees so constructed that the traces may be instantly released and the horse allowed to go free should he become frightened or unmanageable from other cause.

IMPROVED SNOW GUARD FOR ROOFS.

George F. Folsom, Boston Highlands, Mass.—This consists of a right-angled or L-shaped strip of sheet metal that is folded to form a square face, a brace for holding the same, and wings which pass under the slate for supporting the brace. In addition to these features, the square face is slit up for a short distance each side of the brace to form prongs, that spring against the surface of the slate, and, in conjunction with the wings, clamp the slate, so that the guard will not slip from it. The object of the invention is to provide a snow guard for roofs that may at any time be attached to the same, and that will effectually prevent the snow from sliding bodily from the roof.

NEW AGRICULTURAL INVENTIONS.

IMPROVED BUTTER PAIL COVER.

Joseph G. Fisher, Grand Rapids, Mich.—A spring made of elastic wood crosses the center of a bar on the cover, and its ends project sufficiently to allow metal straps, attached to its said ends, and having elongated holes formed in their free ends, to be passed over the heads of small knobs attached to the sides of the pail, so that the cover may be held securely in place by the elasticity of the spring.

IMPROVED PLOW.

Anton Lauer and Julius Hartmann, Louisville, Ky.—This is an improved center draft plow so constructed that there will be no friction upon the landside, and so as to enable the point to be made of steel.

IMPROVED COMBINED STALK CUTTER AND HAY RAKE.

William W. Fuller, Elmira, Ill.—This machine is so constructed that it may be readily adjusted for use as a stalk cutter or as a hay rake. The stalk cutter, the stalk adjuster, and the rake can be raised and lowered by operating a lever.

IMPROVED POWER CHURN.

William H. Sterns, Humboldt, Neb.—By turning the crank, the churn body will be carried around through the arc of a circle, which will throw the milk contained in said churn body into violent agitation, the ribs breaking up the circular currents that would otherwise be formed in the milk.

IMPROVED GATE.

Israel D. Jewett, St. Omer, Ind.—This invention is an improvement in the class of gates which are supported by parallel pivoted bars, and operated by levers, so that in being opened or closed they move in a vertical plane and in the arc of a circle. The improvement relates to the use of a horizontal bar or lever, to which the bars supporting the gate are pivoted, and whose function is to assist in maintaining the gate in a horizontal position.

IMPROVED CULTIVATOR.

Nathan T. Brewster and Abraham D. Neher, Roseville, Cal.—This invention consists in the particular arrangement of a double wrought iron frame combined with cultivator teeth, and separating blocks located between the parts of the frame, one set of which blocks in the front, and also in the rear, of the cultivator form bearings for wheeled axles through which the cultivator is raised for transportation or lowered for use; the particular arrangement of the cultivator being such as to impart to the same great strength and durability, and to permit the same to be readily taken to pieces and used independently of its wheels if desired.

IMPROVED BEE-HIVING APPARATUS.

Reuben B. Oldt, New Berlin, Pa.—This consists in a pivoted case containing two inclined planes that run downward from slots in the top of the casing over which the hives are placed. One of the inclined planes is pivoted, and is capable of moving upward when the shifting of the bees changes the center of gravity of the casing, so that it turns on its pivots. There is also a new arrangement of a mica trap door, which allows bees to escape from the hive from which they swarm, but does not permit them to re-enter.

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Painters, etc., get circular, prices, etc., of New Metallic "Wiping out" Graining Tools; 75,000 now in use. J. J. Callow, Cleveland, O.

Removal.—Fitch & Meserole, Manufacturers of Electrical Apparatus, and Bradley's Patent Naked Wire Helices, have removed to 40 Cortlandt St., N. Y. Experimental work.

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Lead Pipe, Sheet Lead, Bar Lead, and Gas Pipe. Send for prices. Bailey, Farrell & Co., Pittsburgh, Pa.

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The Zero Refrigerator was awarded a grand Centennial medal. Send for book. Lesley, 226 W. 23d St., N. Y.

Silver Solder and small Tubing. John Holland, Cincinnati, Manufacturer of Gold Pens and Pencil Cases.

Patent Scroll and Band Saws. Best and cheapest in use. Cordesman, Egan & Co., Cincinnati, O.

Best Glass Oilers. Cody & Ruthven, Cincinnati, O.

Diamond Drills, J. Dickinson, 64 Nassau St., N. Y.

Notes & Queries

C. H. W. will find articles on the canal boat award in New York State on p. 81, vol. 30.—A. B. will find on pp. 235, 236, vol. 36, directions for coloring brickwork.—J. H. P. can use olive oil in combination with phosphorus in a glass tube. We cannot work out his problem for him.—W. E. N. will find directions for imitating black walnut on p. 90, vol. 32.—J. P. L. will find the dimensions and threads of gas pipe on p. 378, vol. 32.—J. B. B. will find a recipe for lacquer for brass on p. 116, vol. 33.—P. A. F. will find a recipe for a filling for safes on p. 75, vol. 32.—C. D. C. will find directions for polishing brass on p. 298, vol. 29.—J. K. will find directions for skeletonizing leaves on p. 155, vol. 31.—J. W. F. S. will find an article on the manufacture of postage stamps on pp. 208, 277, vol. 27.—G. W. A. should read our article, on p. 33, vol. 33, as to ascertaining the power of an engine.—J. W. P. will find something on the manufacture of starch on p. 154, vol. 30.—C. B. M. will find the proportions of a surface condenser on p. 395, vol. 32.—C. F. F. will find an explanation of the speeds of different parts of a wagon wheel on p. 298, vol. 31. The other question is too absurd to need reply.—E. S. K. will find a recipe for a durable paint for floors on p. 165, vol. 34.—W. M. will find directions for magnetizing steel on p. 37, vol. 31.—E. J. L. is informed that the relative power of different batteries is described on p. 26, vol. 26.—L. B. should read our articles, on pp. 325, 340, vol. 36, on granite and marbleized ware.—M. G. will find directions for melting vulcanized rubber on p. 119, vol. 28. To mend rubber boots, see p. 203, vol. 30.—A. R. will find the flying machine suggestions carefully discussed on p. 112, vol. 32.—H. B. K. will find that the ball dropped into a hole through the earth is discussed on pp. 138, 250, vol. 31.—D. H. will find directions for manufacturing corn starch on p. 154, vol. 30.—W. Z.'s query as to carrying a piece of timber is answered on p. 363, vol. 36.—D. K. H. will find on p. 156, vol. 31, directions for making rubber stamps.—W. B. P. cannot make better manifold transfer paper than is described on p. 278, vol. 28.—A. R. will find a recipe for hair dye on p. 220, vol. 35.—S. J. H. will find on p. 298, vol. 27, directions for preserving insects.—J. C. S. will find a description of a method of utilizing the motion of a ship to pump water from the hold on p. 13, vol. 26.—C. L. will find directions for making charcoal into blocks for filters on p. 395, vol. 32.—H. D. H. is informed that we do not kuow what he means by "enameling on pearl or ivory."—H. C. H. will find directions for waterproofing canvas on p. 347, vol. 31.—W. S. V. can enlarge his designs by using a pantagraph. See p. 179, vol. 28.—Dr. J. Z. T. can make a good rubber cement by following the directions on p. 139, vol. 35. This also answers T. T., who asks for a cement with which to mend a rubber belt.—A. R. F. will find directions for making printers' rollers on p. 283, vol. 31.—W. W. M. will find directions for preserving eggs on p. 219, vol. 31.—E. A. W. will find an excellent recipe for hair wash on p. 138, vol. 33.—L. M. will find a recipe for a depilatory on p. 186, vol. 34.—R. T. P. is informed that no sensible person believes in the efficacy of a madstone.—T. D. is informed that we do not answer legal queries.—R. K. P. will find on p. 37, vol. 31, directions for making permanent magnets.—C. C. T.'s query as to cement for making rubber bags was answered on p. 139, vol. 35.—H. T., J. K., B. L., J. H., W. R., J. B. D., J. L., C. S. F., S. P. F. F., N. J. T., and others, who ask us to recommend books on industrial and scientific subjects, should address the booksellers who advertise in our columns, all of whom are trustworthy firms, for catalogues.

(1) W. A. C. says: I claim that the proper way to get the equation of panel wainscoating, ascending flights of stairs, should be to plumb up from the steps or stringboard. A friend claims that the proper way is to square out at right angles from the stringboard. Who is right? A. Your friend is right, if the object is to make the wainscoting upon the stairs appear of the same width as that upon the level floors of the building. It also requires the same amount of material to construct it per line or foot, measured upon the raking line of the cap moulding, as that upon the level floor following the line of the same moulding.

(2) F. S. asks: If, in a church design, it be desired to use a statue standing erect thirty feet above the observer, what height should be given the figure, according to scale? What is the rule for finding such height? A. Statues when set above the horizontal plane of vision should be sufficiently elongated to compensate for the dwarfing effect of the perspective. This does not refer to the size, but merely to the proportion between the width and the height. If you take a point distant 3 times the height as a proper station from which to obtain a good view of the statue, a line drawn from that point to the base of the statue and another from the same point to the apex, will limit the length of a line drawn across these starting at the base of the statue and running at right angles to the lower line from the eye; this cross line will indicate the height of the statue as it appears to the eye, and should be 6 feet. The statue itself should be of the increased height indicated by the vertical line at the end of the lines proceeding from the eye. But the width of the parts should be very slightly increased, if any.

Why does water discharge more rapidly through a tube than through an orifice of same size? A. It may be from the greater accumulation of the momentum which this form affords over the mere orifice. However, the fact is known, but not the cause.

(3) W. R. H. asks: What is the best method of treating shingle roofs so that the ice will not adhere so tightly near the eaves as to cause the water to back up and leak through? A. The remedy is to line your gutter with tin, and extend the tin up the roof to a width equal to that of 3 or 4 courses of shingles.

(4) M. A. says: I have an underground cistern in good order, which was well cleaned out before letting in water. The water now has a strong sulphurous taste and smell, which I am of opinion is caused by electricity discharged into it by means of the conductor pipes during a severe thunderstorm, as it had not this taste and smell previous to the storm. I am anxious to purify this water for drinking; can you suggest a method? A. The unpleasant taste, etc., of the water cannot be due to the effects of lightning. It may be due to the corrosive action of the water on the lightning rod terminals; but it is far more probable that the trouble is caused by decomposing vegetable matter. Throw into the cistern several bushels of well and freshly burnt charcoal. If this does not improve the water, try a little lime water, first experimenting on a small sample of the water to determine the proper quantity.

(5) D. S. M. asks: What is the shortest and most correct method of computing the cost of a certain amount of lumber at a given price per thousand feet? A. It is considered a very simple operation, and consists simply in multiplying the number of feet by the price per foot.

(6) H. D. D. says: 1. I propose building a boat about the proportions of the Whitehall boat described in your SUPPLEMENT No. 37, but about twice the size, that is, 32 feet long by 8 feet beam. I will put in it a locomotive boiler 6 feet long by 2 feet, with which I will run two oscillating engines about 5 x 7 inches, with a screw 14 inches in diameter and of 3 feet pitch. The screw will work half below the keel, and be so arranged that in shallow water it can be elevated so as not to strike the bottom. This I will do by having a joint on the shaft; and the block by which the shaft passes through the stern post will slide up and down, having a guard running under the screw to a hinge on the keel, which on striking the bottom will force the block up the stern post. Do you think my plan is a good one? A. The screw is rather small, and we think your engines are larger than is necessary. 2. About what will be the draught? A. The draught can be made from 22 to 24 inches.

(7) N. M. H. asks: Can you tell me of a cheap paint or substitute for paint for brick walls? We have been using some old bricks which show stains of mortar. What is a good substitute for oil and Venetian red? A. We do not know of any substitute that will be worth while to try.

(8) F. S. C. says: We are told that sulphate of lime is one of the most insoluble substances we have: in fact, that it cannot be dissolved in water; therefore, if we drink water containing it, it cannot be deposited in the system, causing gravel or other kindred diseases. What I cannot understand is this: Sharon Spring water contains 85 grains of sulphate of lime to the gallon; and when it is drawn from the spring (and that is the time we drink it) it is as clear as crystal, although after it has stood a few hours it becomes milky and opaque. If a little is spilt on the boots, it leaves a mark like a chalk mark. When the water is clear as a crystal, how can the sulphate of lime be otherwise than dissolved? And if dissolved, why does it not become deposited in the system? A. Sulphate of lime dissolves in water; but its solubility is not great. All spring waters contain more or less of it. The opalescent appearance in the water after standing is due to the separation of the other lime salts and carbonate of magnesia on the escape of the excess of carbonic acid, and the oxidation of the hydrosulphate of lime to form sulphate. As to why the lime in solution does not cause gravel and Bright's disease, it would be impossible to give other answer than that, in a healthy condition of the system, means are naturally provided for utilizing part of it as bone food, and for discharging that which is not required.

(9) F. S., Jr., asks: How can I make an artificial stone sidewalk? A. The most important ingredient is a good cement. English Portland cement is generally preferred. Procure a sharp, light-colored sand, and wash it free from all particles of soft earth or soil; also some stone chips, gravel, and large stone. Excavate the sidewalk about 18 inches deep, and fill in the large stone to within 6 inches of the surface; prepare a concrete made of the cement 1 part, stone chips and gravel about 6 parts, and bed it in upon the stone bottom to within 2 inches of the surface; then prepare a concrete of the cement 1 part and fine sand 2 parts, and lay it in up to the surface, floating the surface with the cement at pleasure. Finish by lining off into very regular blocks. A more economical sidewalk can be made by omitting the stone bed, but it will require a good hard soil to lay it on, and then will not be so sure of being permanent.

(10) J. H. D. says: About a year ago I bought some bleached shellac gum, and cut it with alcohol without any difficulty. A few days since, I tried some of the same gum, it having been kept in a dark dry closet; and it would only soften in alcohol, but not dissolve. After trying it in three different purchases of alcohol, I bought some more gum, and it worked all right. I would like to know why I could not dissolve the gum I had on hand? A. Break it into as fine a powder as possible, boil with clean water, and partially dry. We think it will then dissolve readily in alcohol, if the same be not too dilute.

(11) J. B. asks: Can a piece of iron drawn out square be termed wire? A. It would not be wire in the ordinary acceptation of the term.

(12) L. R. says: 1. I asked you some time ago how to clean dirty lubricating oil. You said: "Filter it through plugs of cotton wool." I have taken a large funnel and put raw cotton in it, but it will not work. A. Agitate it with a small percentage of oil of vitriol, and then thoroughly wash it with water by agitation; syphon off the oil, and let stand over quicklime. To filter oil from mechanically contained impurities, fit a small cork, cut star-shaped, in the angle of a funnel, so that it will not impede the passage of liquids, and cover this loosely with cotton wool (raw cotton). If properly arranged, the oil will pass through, leaving the impurities in the cotton. 2. Please let me know how to wash dirty cotton waste? A. A strong, hot solution of soap and washing soda is generally employed. 3. Is there anything better for taking grease off waste than concentrated lye? A. Yes, bisulphide of carbon is much better.

(13) H. S. P. asks: Which runs lighter, a farm wagon with the usual sized thimble-skein axle, or a wagon of same size, etc., with an iron axle the thimble made tapering as usual? Does not the rule hold good in this case that the smaller the spindle, the less the friction? A. Yes, if the pressure does not become so great as to prevent efficient lubrication.

(14) J. McC. says, in reply to A. D. S., who asks how he can clean out his canal without drawing off the water: A very inexpensive dredging machine consists of a small scow, three men, a shovel with a long handle, and a rope. The shovel is made to take up, say a half bushel, and to have a bail to which to attach the rope. This shovel is manipulated by one man at the handle, who thrusts it into the mud, assisted if necessary by the other men pulling on the rope; and when the shovel is full, or supposed to be full, it is lifted up to the scow and emptied by being turned over by the man at the handle. If the canal is not very wide, a small mast and boom can be set up, and the shovel elevated to the end of the boom by running the rope through a single pulley block, when the shovel and its contents can be swung across the scow to the opposite bank, and the dirt deposited there.

(15) C. A. C. says: Please tell me how to stop foaming in a boiler? We have a 1½ horse power upright tubular, in use 15 minutes a day only, for steaming silk. I have tried black oil in vain, and am careful to draw with only ¼ open valve through ½ inch pipe. It operated nicely till we accidentally got a little soapsuds in it. I have blown off 5 times, but it is no whit better. A. Try the plan of running the boiler for a few hours with the blow valve partially open, and a strong feed; if the flow and check valves are so far apart that what is fed in will not be blown out again directly. If otherwise, run the boiler several hours, pumping up with a strong feed, and blowing down as often as practicable.

(16) W. B. says: I have seen it stated that experiments had been made in England not long ago, testing the draught of farm wagons of different construction, and as a result it was found that a wagon with the fore and hind wheels of equal height was the easiest to move on any road or any grade. I wish to have the details of the above experiments or of the construction of the wagon. A. The experiments referred to were probably made by the Royal Agricultural Society of England. If so, you will find full details in their reports.

(17) F. G. W. asks: 1. What is the strength of a boiler 22 inches long, 10 inches wide, and 6 inches high, the heads of which are ¾ inch thick, of cast iron, and sides of wrought tire iron ¼ inch thick? The boiler has round ends with straight sides. A. Carry 35 or 40 lbs. steam. 2. Would it be suitable for an engine having a cylinder of 3 inches stroke by 1½ inches diameter? A. You can probably make the boiler answer for this engine. 3. If I put twelve 1 inch pipes in it, and set it on a common stove, would the boiler be improved? A. It will be more efficient if you use the flues as suggested.

(18) E. P. C. says: My steamboat is using a surface condenser; the boiler is only 8 months old with no grease or sediment in it; but I cannot keep the socket bolts from leaking, and every little while I have to renew them. What is the cause of it? A. In such cases, if the boiler is allowed to receive a very thin coating of scale, the corrosive action is often stopped.

(19) W. R. McD. asks: What can be done to prevent rust in a wrought iron warm-air furnace, enclosed in brick walls, when not in use? Is there not some way to prevent rust without making an application to the iron itself? A. We think you will find this difficult, unless you can expel the air, and seal the furnace hermetically.

(20) G. M. M. says: I have a cellar into which the water comes after a heavy continued rain. It is walled with stone and the walls are cemented. The floor or bottom has 2½ inches of hydraulic lime and gravel. How can I keep the water out? A. To make your cellar perfectly tight may be attended with considerable expense. It would require several coats of asphaltic cement applied on bottom and sides when the cellar is dry, and then loaded with brick or concrete of a weight equal to that of the water when at its highest point. When properly applied this would insure your cellar from water not only, but even from dampness.

(21) A. says: Miramichi (New Brunswick) raftsmen assert that rafted logs make headway through the water in floating down stream—that is, that they always go faster than the current; also that single logs go somewhat faster than the current, but are invariably passed by rafts; they also declare that a log with its ends up and down stream goes down faster than a log which drifts down sidewise. A. We would like to be sure that these assertions are founded on fact before attempting an explanation.

(22) W. W. E. says, in reply to A. D. S., who asked as to cleaning out his mill race: Put in sluice gates about every 200 or 300 yards, the bottom of which should be 12 or 18 inches below the bottom of the canal: then open one gate at a time, so as to drain the water from the canal, and the water will carry the mud and sediment with it. To facilitate the moving of the mud, put a small punt or flat-bottomed boat in the canal, get in it, and rock it until the water is moving rapidly under it. This has been my practice for 20 years. One hand can thus move more mud in one day than 20 hands can with shovels.

(23) O. H. Y. says: I would say to E. C. H., who asks how to put Babbitt boxes on a shaft without their becoming fast. Oil the shaft slightly and sprinkle the surface lightly with powdered plumbago. The shaft will slip out very easily and all the little holes in the box will be filled with a valuable lubricant.

(24) J. L. M. asks: Is there any process by which tin can be brazed? I wish to make a large number of smooth metal tubes capable of resisting mild acids. A. You fail to state what kind of acids. As a general thing, any ordinary metal or alloy cannot be trusted with even dilute acids. If the acid is dilute sulphuric, copper, lead, or an alloy of these may be used; but neither of these entirely resist the action of even very dilute muriatic, nitric, acetic acids. Tin offers more effectual resistance to some of them as it is seldom pure, it will also give way after a time. Perhaps the best, and certainly the most economical, way would be to enamel the exposed parts of the metal (see p. 21, vol. 36); or if this is impracticable, coat them with a varnish made of gutta percha, caoutchouc, or a mixture of the two dissolved in coal naphtha.

(25) W. E. says: I have a wooden tank to keep silver solution in. I tried pure pitch for lining, but the solution ate holes in it. What is the composition that is used for lining wooden tanks to hold silver solution? A. Wooden tanks are not best for silver baths. Use a paint made by dissolving equal parts of gutta percha and gum rubber in hot coal naphtha. Heat the naphtha over a large water bath.

(26) I. Q. G. asks: How can I paint a sign and apply smalt blue? What is used to make the smalt adhere, and how is it applied? Is the smalt dusted on and left till the background is dry? A. Dust in on a background of oil size.

(27) C. E. G. asks: What can I put into paraffin oil to prevent it from staining cloth, not destroying its lubricating qualities? A. We know of nothing.

(28) G. B. asks: How can I make gunpowder and gun cotton? A. For gunpowder the materials (charcoal, sulphur, and saltpeter) are first perfectly dried and separately reduced to impalpable powders. These are then sifted together, moistened with water, and ground for some time between large millstones kept constantly moist with water. The wet powder is then collected into large lumps and carefully dried. These lumps are grained by bringing them in contact with sharp teeth fixed upon the periphery of a revolving wheel, and agitating in suitable sieves to separate from the finer powder. The powder consists of 76 parts of niter, 13 parts of charcoal, and 11 parts of sulphur. Gun cotton is made by immersing clean dry cotton for a few moments in a mixture of equal parts of fuming sul-

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phuric and nitric acids, and then washing the acids off in running water. The acids must be those known as fuming—the most concentrated.

(29) J. D. R. says: In the study of geology, I meet with one serious difficulty: There are five principal geological periods, each of which has its characteristic formations. Geologists speak of the the "oldest rocks," the "lowest rocks," etc. All their examinations are necessarily confined to the earth's surface. How, then, do they ascertain which are the lowest or oldest rocks? I understand that eruptions might heave the rocks of the interior to the surface, and that rocks of all periods might be found on the surface; but how do geologists ascertain the period to which a given rock belongs? How do they tell the age of a rock? A. The older rocks—granite and basalt—are those upon which rest the stratified deposits constituting gneiss, sandstone, etc.; they are, therefore, often spoken of as the lowest, the foundation stones. They are unquestionably the result of direct congelation from a state of fusion; while the sandstones, etc., are as evidently the product of the corrosion and attrition by violently agitated water of high temperatures. The material thus abraded and dissolved, at first held in suspension by the water, was gradually deposited and cemented as it calmed and cooled. The rocky crust, at first formed, had become wrinkled into great valleys and mountain chains by the shrinkage of the still molten nucleus and the falling in of the weaker portions of the crust. The valleys received most of the sediment, while the mountain tops, some of which projected above the surface of the water, were lightly or not at all thus clothed. Denuding floods and glaciers have since laid bare portions of these foundation rocks or cut great chasms in them, so that geologists may, without great difficulty, study their nature and that of the superincumbent strata. The order of their formation, their inclination, thickness, stratification, and nature, are the data from which their relative ages are computed. Space will not here permit us to go further into the subject. You should consult some comprehensive works on geology and on the age of the earth.

(30) E. J. W. says: I have a wood-turning lathe, the cone pulley of which has two steps, one is $3\frac{7}{16}$ inches, and the other $9\frac{11}{16}$ inches in diameter. From center of spindle to center of countershaft is $31\frac{7}{8}$ inches. With the $3\frac{7}{16}$ inch step I am running a pulley on the countershaft $29\frac{7}{8}$ inches diameter. I wish to put a pulley on the countershaft to run with the $9\frac{11}{16}$ inch step, and to use the same belt on either step. What must be the size of the pulley? A. Make it $9\frac{7}{8}$ inches.

What is the weight and value of a cubic inch of gold? A. About $8\frac{1}{3}$ troy ozs. Worth about $173.

How much heavier is a cubic foot of sea water than a cubic foot of fresh water? A. About $1\frac{3}{4}$ lbs.

(31) C. A. R. says: I desire a compound in liquid form, without offensive odor, which, when applied to ordinary writing paper or wood, will penetrate the same and adhere firmly thereto, and that will dry quickly when spread thinly, and exposed to the air. When dry, it should be transparent and insoluble in water. A. Perhaps an ethereal solution of balsam will answer your requirements.

Can you tell me what to add to silicate of soda to make it dry quickly when spread thinly? A. No. Use the solution hot.

(32) A. J. Z. & S. ask: 1. Is coal tar from gas houses a good thing to put on a shingle roof to preserve the wood? A. The use of coal tar as a roofing paint is open to a number of objections, chief among which are its black color and low point of fusion, which cause it, under exposure to strong sunlight, to readily absorb heat and run into the gutters, and its strong odor. Besides this it is very inflammable, and easily ignited. 2. Is there a cheap ingredient that can be mixed with it to make it dry, and to prevent it from smelling? A. The odor and liability to run may be somewhat reduced by mixing it with lime. It will not rot the wood.

(33) H. F. asks: How can I feather or crystallize on galvanized iron? A. Clean it perfectly with a solution of chloride of zinc, and you will find that the coating is already crystalline. Or use a wash of dilute nitric acid (1 of acid to 1 water), and wash in a stream of clean water.

(34) J. M. B. asks: What is the best material for a step in which a steel spindle, weighing about 1 lb., is to revolve at 4,000 turns per minute? A. Use hardened steel or iron.

(35) F. C. asks: How is the dotted shade put upon crayon drawings? A. If we understand you, the shade is composed of small dots worked in with the crayon point. 2. How can I obtain a solar print from a tin type? A. A negative of the picture is taken and is placed in front of the lens of a large camera and behind, but within the focus of, a large condensing lens. The sensitized paper extended on a frame is then introduced into the camera and exposed. The cameras used for this purpose are peculiar in shape, very long, and are provided with suitable machinery, clockwork, etc., to maintain them in the same relative position with respect to the sun, during the time of exposure.

(36) W. C. R. says: A calcium light company has several different sizes of gas cylinders in use, holding 15, 25, 50, and 60 feet of gas; and when each one is fully charged and sent out, its pressure gauge will indicate the same number of lbs., namely, 225 lbs. to the inch. By what rule can I ascertain how many feet have been used, and how many still remain in the cylinder? A. The pressure varies nearly as the quantity of gas in the reservoir; so that, when the gauge shows a pressure only half as great as the original, about half of the gas has been used, and so on. A simple method of ascertaining the contents would be to weigh the reservoir when empty, and with a definite amount of gas. From this the weight of a cubic foot of gas could be ascertained, and, by weighing the reservoir at any time, a simple calculation would show how much gas it contained.

(37) L. N. M. asks: 1. What will prevent ordinary shellac varnish from bubbling under the brush, when applied to a rough surface? A. Thin with alcohol, and give a flowing coat. The wood must be dry. 2. In repainting defaced water colors, which would be best, colored varnish or common paint, or would neither of them answer the purpose? A. You do not say what kind of a color. Probably colored varnish would give the best results, if we understand you.

(38) S. asks: Does the diameter of an eccentric affect the position of a valve, that is, will not a locomotive work as well with one eccentric of 10 inches diameter and the other of 12 inches, as it would were both equal, providing that the throw is the same? A. There is a slight difference on account of the increased angularity of the eccentric rod. All other things being equal, the small eccentric is best.

(39) E. D. S. asks: How can I split $\frac{3}{4}$ inch square iron either hot or cold? A. If the bar is heated to a red heat, a circular saw will answer. If the bar is cold, a fast running disk of sheet iron will cut it.

(40) G. W. R. asks: Can a steam cylinder of 3 inches bore work a 20 inch stroke? A. It would work, but would be very much out of proportion.

(41) J. W. C. asks: Can iron be welded without being heated to a welding degree, by the use of any chemical? A. No.

(42) W. F. S. says: A friend of mine says the Dead Sea is devoid of fish. I do not see why there should not be fish there as well as there is in any other water. Who is right? A. It is said to be lifeless, as its waters contain a very large quantity of chloride of magnesium, chloride of sodium, and sulphate of soda. A bath in its waters parches and cracks the skin.

(43) J. J. T. asks: How is it that all bought taps are so clean and bright? How are they tempered? A. The taps you refer to are not heated in the open fire but in heated mixtures, the composition of which we shall shortly publish.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the result stated:

J. S. B., of Cal., sends us a box marked with his initials, but no letter. It contains pieces of red jasper and quartz, with oxide of iron. The bright specks are not gold, but iron pyrites.—B. J.—No. 1 is clay with red oxide of iron. In. No. 2 the bright specks are mica films, it contains no metals.—J. B., Jr.—It is red oxide of iron with clay. It is used as paint, under the names of ocher and umber.—G. B.—The crystals in No. 1 are lime iron garnets. No. 2 contains hornblende, albite, and orthoclase.—J. D. S.—No. 1 is iron pyrites in limestone. See p. 7, vol. 36. No. 2 contains carbonate of copper (malachite), limestone, and orthoclase. No. 3 contains galena (sulphide of lead). No. 4 is limonite, with a few crystals of pyrites.—A. D. T.—The material is an infusorial or diatomaceous earth. It contains very fine specimens of *plurasigma, lanceolatum,* and *p. angulatum.*—A. J. A.—No. 1 is pyrites (sulphide of iron). See p. 7, vol. 36 No. 2. See "Hints to Correspondents," this page.—G. & B.—It is metallic antimony.—G. W. H.—It is bituminous shale. You will probably find coal by going deeper. Some of the shale might be used as fuel, but it contains much ash. Dr. M. B.—It is sand from decomposed granite, and is of no value.—H. M. H.—It is a kaolin (silicate of alumina) containing much talc or hydrous silicate of magnesia. It is not suitable material for crucibles, but might answer for soft firebricks.

J. H. B. asks: Is there any remedy for a parrot which, for four or five years, does nothing but pull his feathers out as fast as they appear?—C. B. T. asks: Can any one give me a recipe for manufacturing palatable cider from wild crab apples?—A. I. asks: Has there been anything invented to throw a paddle wheel off of its center? Many such wheels, and stationary engines also, stop in the dead center, and have to be pried off before they can start again.—G. S. says: I have seen in machine shops straight bars of iron 2 feet long, bolted on to shafting at different points and standing out at right angles. What are they for?

HINTS TO CORRESPONDENTS.

Correspondents whose inquiries fail to appear should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them. The address of the writer should always be given.

Inquiries relating to patents, or to the patentability of inventions, assignments, etc., will not be published here. All such questions, when initials only are given, are thrown into the waste basket, as it would fill half of our paper to print them all; but we generally take pleasure in answering briefly by mail, if the writer's address is given.

Hundreds of inquiries analogous to the following are sent: "What do iron and steel rails cost? Are electric medical belts good for anything? What will a compression pump cost? Who sells incubators and brooding apparatus, and what do they cost? Where can powder paper be obtained? What does selenium cost per lb.?" All such personal inquiries are printed, as will be observed, in the column of "Business and Personal," which is specially set apart for that purpose subject to the charge mentioned at the head of that column. Almost any desired information can in this way be expeditiously obtained.

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INDEX OF INVENTIONS

FOR WHICH

Letters Patent of the United States were Granted in the Week Ending

May 8, 1877,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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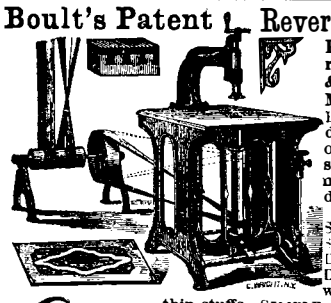

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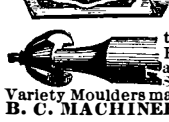

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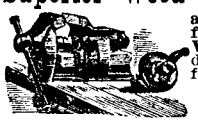

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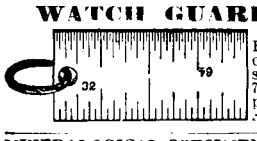

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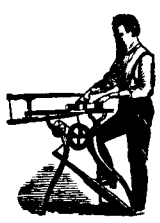

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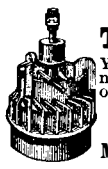

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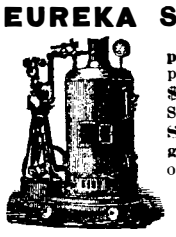

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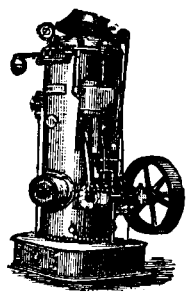

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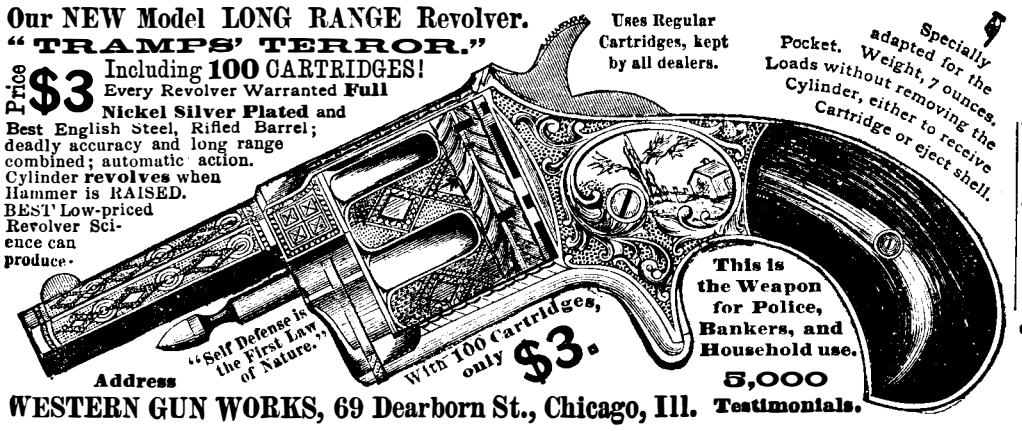

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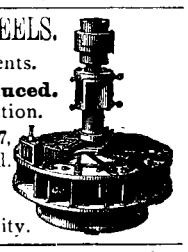

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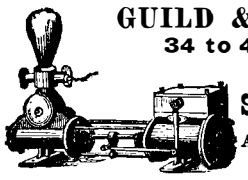

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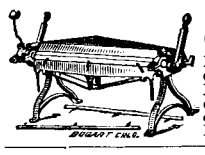

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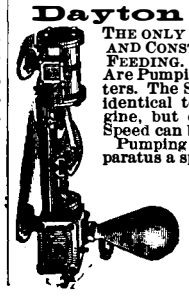

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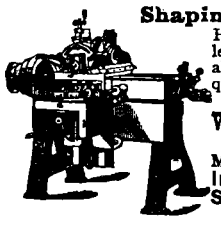

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